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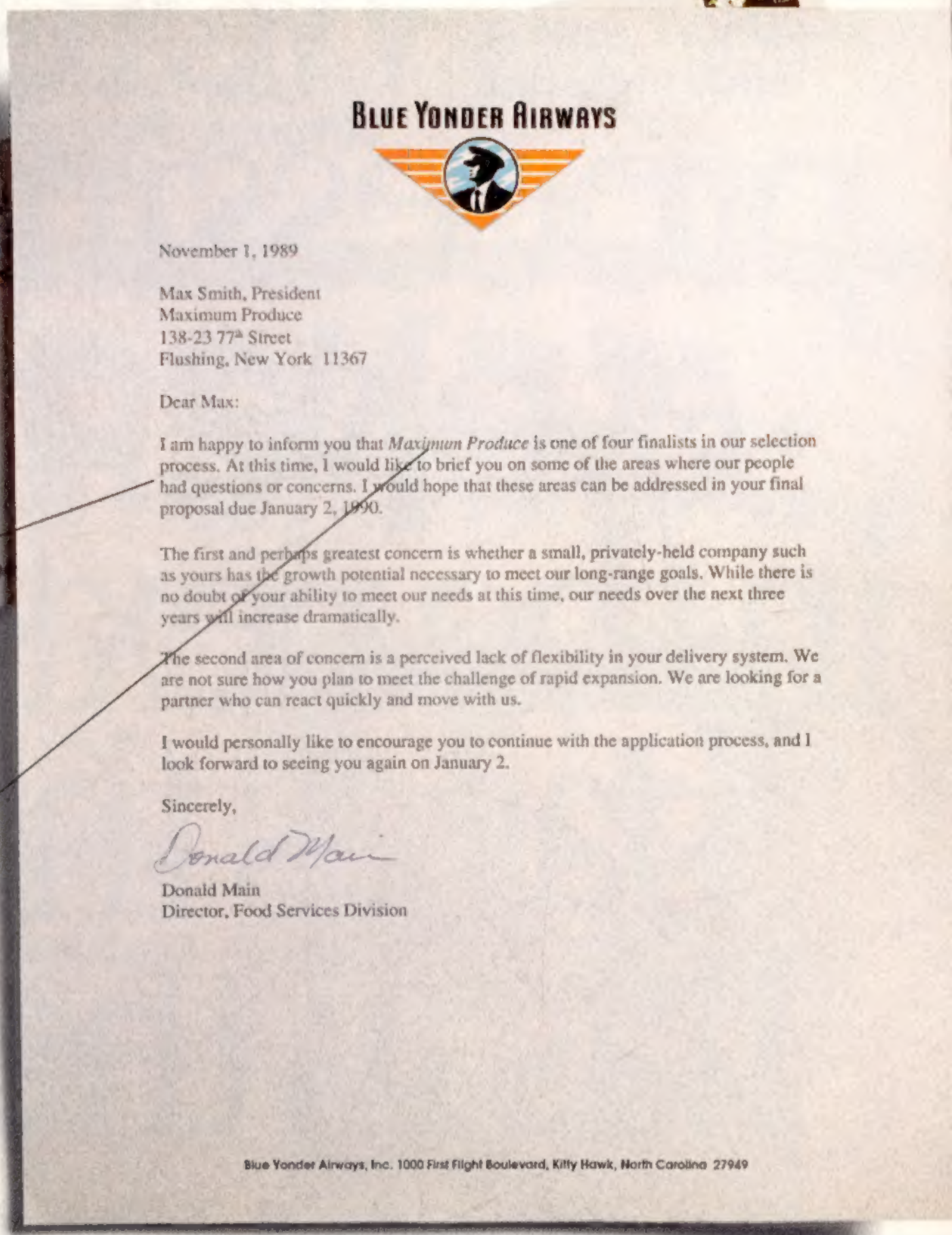

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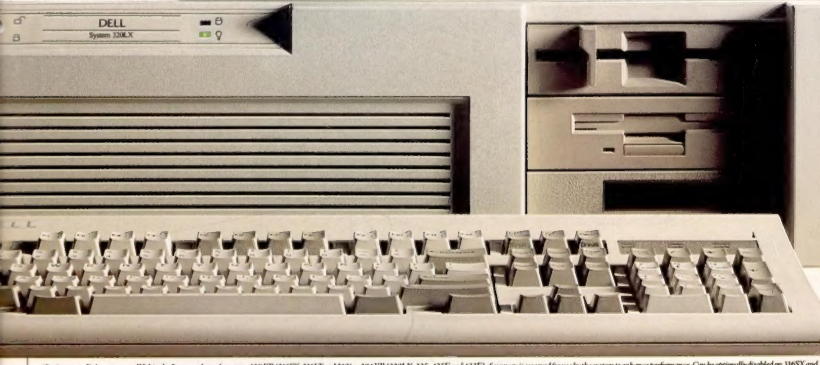

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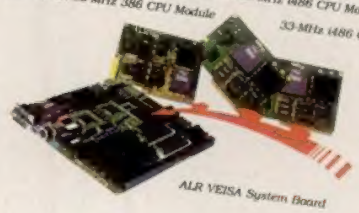

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Inside

Impressive numbers are at the heart of every *PC Magazine* review. Most often, they report the increasing levels of performance on PC Labs benchmark tests. In this issue's "The Cheapest 386SXs Ever," the numbers involve bang for the buck as we review 21 80386SX PCs you can buy for well under $2,000. When the first SX PC shipped from Compaq in the summer of 1988, the same performance cost from $5,000 to $6,000.

PC Magazine also generates impressive numbers behind the scenes, ranging from the number of products logged in by PC Labs (more than 30,000 last year) to the number of products reviewed in one issue (109 printers, 104 PCs, 73 portables, 55 word processors) to the number of people involved in fact checking every issue of *PC Magazine*. In fact, every one of *PC Magazine*'s 90 editorial staff members is involved to some degree in ensuring the accuracy of *PC Magazine*.

By phone and by fax, both reviewers and editorial assistants verify every cell in every features table, and the prices and configurations in the Fact File boxes accompanying each story. PC Labs staffers double check that benchmark test results are accurately transcribed from testing scripts to the electronic tables driving the 3-D benchmark charts that have become a *PC Magazine* trademark. As the issue nears publication, members of the production staff call every phone number one last time.

We'd love to go through an issue without errors, but unlike the machines *PC Magazine* reviews, we're only human. Recently, a review listed the wrong number for Compaq Computer Corp.; callers ironically wound up reaching a neighbor of Compaq CEO Rod Canion. To set the record straight, the last page of the Letters column is reserved for Corrections & Amplifications; errors more silly than serious (identifying the Oakland Bay Bridge as the Golden Gate Bridge, for instance), may wind up in the Abort, Retry, Fail? humor column.

Editorial assistant Joe Antinori and lab assistant Lisa Reittinger did fax machine duty throughout this issue's fact-checking process.

Some of *PC Magazine*'s most popular issues have been those ones where we have reviewed the most affordable PCs on the market: PCs, XTs, ATs, 20-MHz 386s, this issue's complete systems you buy for $1,850 or less; systems that with a hard disk and a VGA color

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PC MAGAZINE® August 1990

Volume 9 Number 14

UP FRONT

4 **INSIDE**

15 **LETTERS**

27 **ADVISOR**
Lori Grunin/ Standing a CPU on its side; changing colors; custom cabling; dialing PC MagNet in Europe.

33 **FIRST LOOKS**
SPC's *Harvard Graphics* 2.3 adds hypermedia capabilities.
Microsoft's *PowerPoint* brings Mac-like presentation graphics to *Windows* 3.0.
Turbo C++: Borland climbs on the C++ bandwagon.
Hercules Graphics Station and Desktop Computing's AGA 1024: low-cost, high-resolution TIGA-based graphics.
VP to the Max: Ventura utilities.

53 **NEW AND IMPROVED**
Matthew J. Ross

61 **READ ONLY**
Lori Grunin

64 **PIPELINE**
Gus Venditto

69 **BILL MACHRONE**
It's Nice to Be Needed: IBM Comes Home

75 **JOHN C. DVORAK**
Will Intel Corner the PC Market?

77 **Inside Track**

81 **JIM SEYMOUR**
Turning Software to Unexpected Tasks

89 **WILLIAM F. ZACHMANN**
What's Sexy vs. What Works

COVER STORY

33 **FIRST LOOKS**
IBM's PS/1 Removes the Hassles and Delivers Decent Performance for Beginners
Gus Venditto/ You're up and running in 10 minutes with IBM's compact, 286-based PC.

FEATURES

95 **COMPUTERS**
The Cheapest 386SXs Ever
Alfred Poor/ PC Labs tests 21 inexpensive but high-quality 386SX machines that are nudging 286 systems out of the marketplace.

102 ACMA 386SX
104 Amax 386SX Business System
109 BroadAx BSI 386SX
113 CAF Master 386SX/16
115 Computer Market Place Ultra 386SX
117 Coté 386 Plus
138 C^2 Microsystems 386SX
138 Dyna Micro Work Master 386SX
99 Editor's Choice
110 Features Table
140 EXP 386SX
142 Fortron NetSet 386SX
149 Gateway 2000 80386SX
150 HiQ386SX-16/20
153 Micro Express ME 386SX
154 Mitsuba MIT-SXA
154 National Micro Systems Flash 386SX-16
159 Novas 386SX-16
162 Pan United PC 386/SX Business System
167 PCC 2260/16SX
167 PSG 80386SX/1
168 Tenex 386 HD VGA System
175 Treasure Chest T 386SX
120 Performance Te

179 **UTILITIES**
Memory Diagnostic Software: Pinpointing RA Ailments
Bill O'Brien/ *AMIDIAG, CheckIt, DR-Chips, Q and Service Diagnostics: The Kit*. These kits are than just system setup and reporting utilities. Th examine your RAM bit by bit, looking for prob

180 Editor's Choice
182 Performance Tests
190 Features Ta

FEATURES

211 HARDWARE
Mice and Trackballs: Choices for the New Generation of Applications
Mary Kathleen Flynn/ To point you toward the right equipment to fully exploit *Windows*, Version 3.0, PC Labs tests 34 mice, 20 trackballs, and 4 light pens.

236 Features Table 267 Editor's Choice
246 Light Pens: The Specialized Alternative

281 FILE CONVERSION UTILITIES
Solving Your Image Problems: Three Conversion Utilities for Graphics Files
Robin Raskin/ Need some help in the Babel of bitmapped graphics file formats? Three conversion utilities can translate between at least nine different formats and convert color images to black and white.

303 COMMUNICATIONS
Speed, Price, Convenience: Fax Boards Deliver
Mike Byrd/ Fax boards are saving trips to the standalone fax machine; the 18 products tested offer the functions you need—for under $500.

304 Editor's Choice
314 Features Table 328 Performance Tests

363 SOFTWARE
1-2-3/G: The Super Solver
Craig Stinson/ The Solver, a fascinating new feature of Lotus's Presentation Manager–based version of *Lotus 1-2-3*, assesses your business's resources and calculates the most profitable way to use them.

381 CONNECTIVITY
Building Workgroup Solutions: Multiuser Graphics Terminals
Paul Ferrill/ Text mode, move over: the smart designs of Advanced Micro Research's VGNA, SunRiver's Fiber Optic Station, and Viewport Technology's VPT System 2000 allow you to run heavy graphics applications efficiently on multiuser terminal systems.

382 Editor's Choice 384 Performance Tests
383 Features Table

480 Direct Marketing Connection
500 Marketplace
509 Reader Service Card
533 Editorial Product Index
534 Advertisers' Product Index
536 Coming Up
539 Index to Advertisers

PRODUCTIVITY

407 **LAB NOTES**
Exploring and Organizing your Hard Disk with Lotus's Magellan *Neil J. Rubenking*

415 **UTILITIES**
Compile your Batch Files for Added Speed with BAT2EXEC *Douglas Boling*

429 **ENVIRONMENTS**
Taking Advantage of the 386: The 32-bit Version of OS/2 *Charles Petzold*

435 **POWER PROGRAMMING**
Application Development Using OS/2 2.0's Memory Management *Ray Duncan*

441 **WINDOWS**
Gus Venditto/ How to associate data files with programs; start *Windows* 3.0 sessions with File Manager.

447 **DATABASES**
Trudy Neuhaus/ A tour of *Reflex* 2.0 highlights the differences between flat-file and multifile databases.

453 **SPREADSHEETS**
Craig Stinson/ Move linked files from *Lotus 1-2-3* to *Quattro Pro*.

461 **THE WORKING WORD**
Craig L. Stark/ WordPerfect: add light bar menus to 5.0 and break the 32-font limit in 5.1.

463 **USER-TO-USER**
Neil J. Rubenking/ Case-insensitive comparisons in batch files; multiple system configurations.

467 **TUTOR**
Jeff Prosise/ An in-depth look at TSRs.

475 **CONNECTIVITY**
Frank J. Derfler, Jr./ Link distant LANs; a software-only LAN Fax gateway; stop unauthorized file access.

AFTER HOURS

537 ■ Contributing editor (and attorney) Winn L. Rosch takes a look at software that helps you with your legal problems.
540 ■ *Loom* leads gamers on a musical, magical journey.
540 ■ *Shufflepuck Cafe:* Air hockey from outer space.

542 **ABORT, RETRY, FAIL?**
Bill Howard

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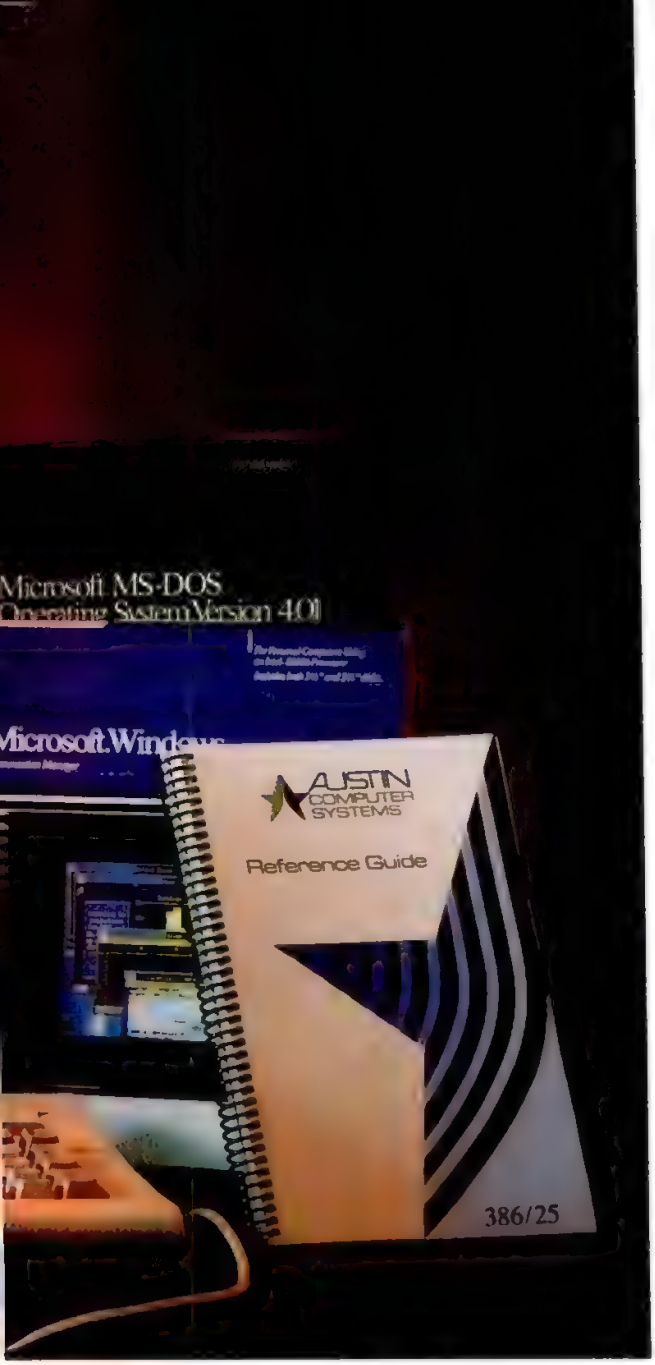

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microLaser™ from Texas Instruments: the affordable PostScript printer you can call your own.

Finally, for less than $3,000, you can have a PostScript laser printer right at your desk. TI introduces its new microLaser, with the features you want – now and in the future.

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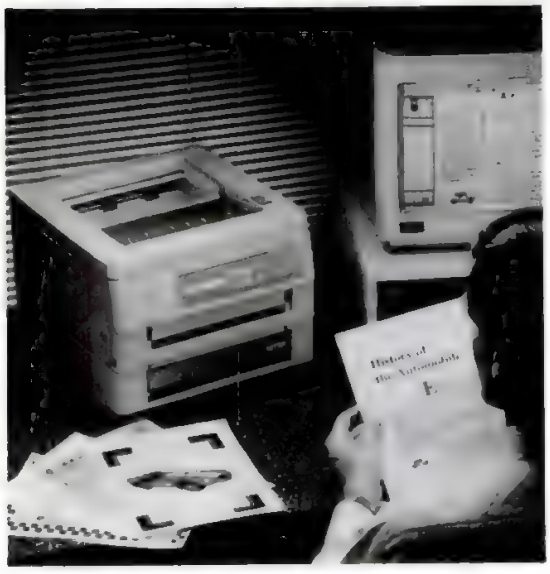
At only 13.4 inches wide and 14.2 inches deep, microLaser may be the small kid on the block, but it packs plenty of punch. This printer takes full advantage of the advanced software that runs on your PC. That's because it uses the Adobe® PostScript printer language and is compatible with the HP LaserJet® Series II – allowing you to switch between them easily. With that kind of flexibility, the six-page-per-minute microLaser is ideal for word processing, spreadsheet and desktop publishing applications.



Because microLaser features the PostScript language, you can print fonts in a variety of typestyles and sizes. Plus, you can print them tall-ways, long-ways, all kinds of ways. You can even print complex pages of integrated text and graphics.

Capabilities that grow as your needs grow.

One of the best things about microLaser is that you only buy what you need. So if you're not ready for PostScript language, you can buy the standard microLaser for less than $2,000 and add PostScript software and other powerful features later.

You can upgrade microLaser without tools or technicians by simply adding upgrade boards. These boards include up to four 1Mb increments of memory, serial and AppleTalk® interfaces and a PostScript interpreter. All you have to do to get additional fonts or emulations is plug optional microCartridges into two credit card-size slots.

Superior paper handling.

Part of what makes microLaser a truly personal desktop laser printer that takes up so little room is its paper drawer, which slides *inside*. Because microLaser holds *250 sheets* standard (it holds 500 when you add an optional paper drawer), you spend less time refilling paper and more time creating superb-looking documents.

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How do you enter the world of PostScript with its high-quality scalable fonts, integrated text and graphics, and broad software support? Buy TI's new microLaser PS17 – the laser printer that offers you more scalable fonts and other features, proving that great things come in small packages.

At just half the footprint of the HP LaserJet III, microLaser PS17 not only offers 17 scalable fonts (LaserJet III offers eight), they're *PostScript* fonts – the industry's standard for high quality. That means more than 4,000 software programs take advantage of microLaser's PostScript font capabilities.

Plus, microLaser PS17 offers the same superior paper handling as other microLaser models, is easily upgradeable and comes at a desktop price.

Why would you consider anything else?

Call TI at 1-800-527-3500 to find out more!

The printer also handles a variety of paper sizes and types – from letter, legal and executive to transparencies, labels and envelopes. For those times when you're facing a large mail merge task, just plug in an optional envelope feeder to easily alternate between letters and envelopes.

Your own PostScript printer is a call away.

To find out more about how you can have affordable PostScript printing right at your own desk, call TI today.

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TEXAS INSTRUMENTS

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Standard microLaser is HP LaserJet II-compatible, prints six pages per minute and comes with .5 Mb of RAM. microLaser PS17 and PS35 have the same features as the standard microLaser, plus an Adobe PostScript interpreter with 17 or 35 typefaces and an extra 1 Mb of RAM. microLaser is a trademark of Texas Instruments Incorporated. Adobe and PostScript are registered trademarks of Adobe Systems, Inc. LaserJet is a registered trademark of Hewlett-Packard, Inc. AppleTalk and Macintosh are registered trademarks of Apple Computer, Inc. *TI suggested list price for microLaser model PS17.

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Letters

THE GREAT LAPTOP DEBATE

Bill Machrone, in his May 15, 1990, column about laptops, sounds like the kid who got a candy bar and then realized he could have had a banana split with the works.

The Compaq LTE is far superior to the NEC UltraLite, for it is not just a portable, do-some-things computer. It is a complete, standalone desktop computer the size of a notebook. Having a hard disk and a floppy at hand transforms a notebook from a travel-only system to a use-anytime system.

I have the 20MB hard disk about 60 percent full with essential programs, including word processing, database, graphics, authoring language, compilers, spreadsheet, and more. When I need something, it's there. I don't have to go to my desktop computer.

Bill can keep his candy bar. I'll take the banana split.

Ed Kidera
Columbia, Maryland

WHY WINDOWS?

I was shocked to see a new column devoted entirely to *Microsoft Windows* (*PC Magazine,* May 15, 1990). Come on, give me a break! This is the biggest waste of printed space I can imagine. I'll give you three good reasons. First, *Windows* is incredibly slow. Second, people who are scared of the command line interface buy the Macintosh. Third, there are dozens of good shell and memory swapping programs that do everything *Windows* does and better.

Why not have a column devoted to graphics in general? You could use it to discuss *Windows* for a month or two, and then go on to more interesting topics. Did someone at Microsoft slip you guys some money, or are you just beginning to believe their PR? *Windows* isn't there yet, so don't waste any more of our time or your money promoting it.

Lawrence Blume
New York, New York

The debate continues over which notebook PC flies higher.

PC MAGAZINE You are obviously behind the times. *Windows* is here and it's here to stay. We at *PC Magazine* believe in being on the cutting edge, and as the next year proves itself to be a *Windows* year we'll have been there from the start. Let us know what you think a year from now.—*Tony Rizzo*

MISSED CONNECTIONS

I believe there is a mistake in your article ("The Audio Visual Connection: Turnkey Multimedia from IBM," *PC Magazine,* May 15, 1990). According to the graphic on page 164, the audio input is connected to the Video Capture Adapter (VCA), the video input is attached to the Audio Capture and Playback Adapter (ACPA), and the audio output is attached to the 8514/A adapter. Your text says the audio input and output go to the ACPA and the video input goes to the VCA. I'm not sure what the 8514/A is for other than to drive the color monitor.

Darryl Crum
Elgin, Illinois

Although I know little about the IBM Audio Visual Connection, I would bet dollars to doughnuts that the audio would sound much better if plugged into the Audio Capture and Playback Adapter, rather than the Visual Capture Adapter (as your diagram depicts). And I may be missing something here, but last time I looked there was no audio output on the 8514/A adapter.

Maybe you should consider renaming your feature to "Abort, Retry, Fail, Ignore," since I am certain that the latter is what you will choose to do about this reply.

Frank J. Reda
New Brunswick, New Jersey

PC MAGAZINE In this case, artistic license swept past technical accuracy. Unfortunately, last-minute changes to the illustration that color-coded the elements also scrambled the connections. The text was right, the graphic was wrong.—*Alfred Poor*

CLIP ART FOR QUATTRO

Thanks for an excellent roundup ("Spreadsheet Heavyweights Take on 1-2-3," *PC Magazine,* April 24, 1990) of the current challengers to *Lotus 1-2-3*. *Quattro Pro* is the best choice in spreadsheets, especially for those of us with a 640K limit. And with its *1-2-3* menu tree there is no learning curve, and no need for messy translations of my existing macros!

I do feel it necessary to point out one error in Catherine D. Miller's review. She states that *Quattro* "can't import third-party clip art." However, in the same issue, in his Spreadsheets column, Craig Stinson correctly states that "Marketing Graphics, of Glen Allen, Virginia, sells libraries of clip-art images" that can be imported into *Quattro Pro*.

Anthony Tortorelli
Westport, Connecticut

WANTED: A COLUMNIST WITH VISION

Yes! Jim Seymour is right in his May 15, 1990, column that a "fax machine, scanner, and laser printer" all in one sounds great. But I've been looking for a fax machine, scanner, laser printer, *and* copier all in one for our office of the future.

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Letters

Guess I'll just have to wait for a visionary columnist to request it first.

John Bollock
Washington, D.C.

Bravo, Jim Seymour! I await this integrated computer system. However, let's take this one step further and make this system a copier, too. After all, if we already have the scanner and laser printer, why not take this system to its logical conclusion. Whoever comes up with a system like this at a price we can afford will become very rich.

Paul A. Dierks
Port Huron, Michigan

INSIDE TRACKERS

Bravo to John C. Dvorak for another one of his highly educational iconoclastic columns.

In his May 15, 1990, "Inside Track," he flays NCR's efforts to curb the use by others of the expression "tower" by saying that "NCR, a company with tremendous engineering resources, should find better ways to spend its time. . . ."

I think that rather than watching NCR waste engineering talent we are witnessing some legal department "proving" its "usefulness" (never mind the bad press, that's PR's problem) to its employers.

George Clemenceau would feel at home: "Lawsuits are too important a matter to be left in the hands of mere lawyers."

Marc Dufour
Montreal, Quebec

John C. Dvorak seems pretty concerned about the resurgence of copy protection and a renewed movement to quit trusting customers (*PC Magazine*, May 15, 1990). I just wish he would have gone all the way and mentioned shareware as a viable alternative. These authors *trust* people to pay for the software they use. It's powerful stuff, too. You guys have bestowed Technical Excellence awards on a fair number of try-before-you-buy programs.

But still, I'm curious. Do retail software companies buy a copy of DOS, *Lotus 1-2-3*, *dBASE*, and *WordPerfect* for each computer in their testing labs? It seems to me they should, or else they're pirates by their own logic.

Rob Rosenberger
O'Fallon, Illinois

Maybe John C. Dvorak has a voice loud enough that people involved with copy protection will listen.

I fail to understand why software publishers don't realize that copy protection seriously diminishes the utility of a program and punishes the honest purchaser by adding needless levels of complexity.

My dollars go to companies who don't (by inference) accuse me of being a dishonest user.

Alan D. Applegate
Lakewood, Colorado

PIXEL BY PIXEL

I read your piece ("1024 Monitors," April 10, 1990) with great interest, but I'm puzzled by an apparent contradiction between the claimed resolutions and the measurements you quote.

You have measured the line widths for each color for all of these monitors. I have taken these values and divided them into the monitor widths and heights, and I end up with far fewer lines than the claimed VGA or 1,024 by 768 resolutions. Furthermore, these calculations were done for each line width. Presumably, a full color pixel comprises three lines (or spots), so the resolution should be one-third of what I have calculated. Am I missing something vital?

Of course, you haven't specified the luminances at which you measured line widths. If the luminances were dramatically reduced, the line widths would also be reduced. No shadow-mask tube illuminates only one spot at a time even at very low luminances; typically the electron beams illuminate from 1.3 to 2 triads, as your pictures illustrate. Using the 1.3 figure, I think you'll find that none of these CRTs can produce their rated resolutions.

Alan Sobel
Evanston, Illinois

Basically, you are correct that a single-pixel width beam illuminates more than one phosphor dot. The reason that your calculations indicate fewer lines per screen is that the beams for each line of pixels overlap at the edges. Our measurements were based on the width of the beam at the 50 percent brightness point. If the beams did not overlap, you would get a pronounced pinstripe effect in regions of solid color, while a beam that is too wide causes a blurred image. And though I did not count each pixel, I'd trade my VGA monitor for any one of these.—*Alfred Poor*

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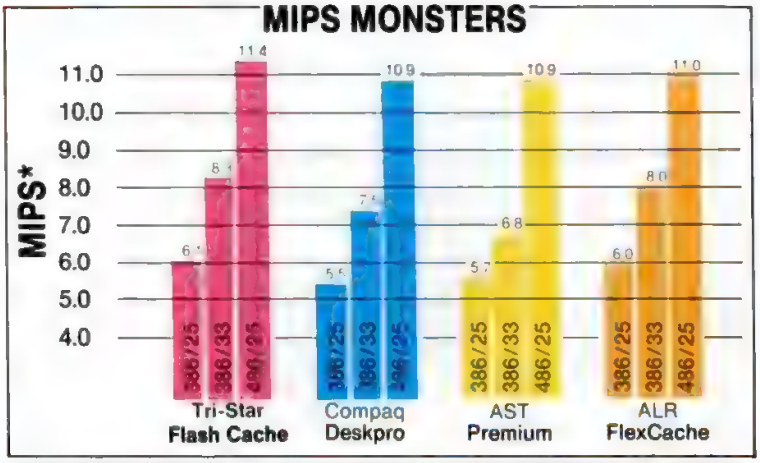

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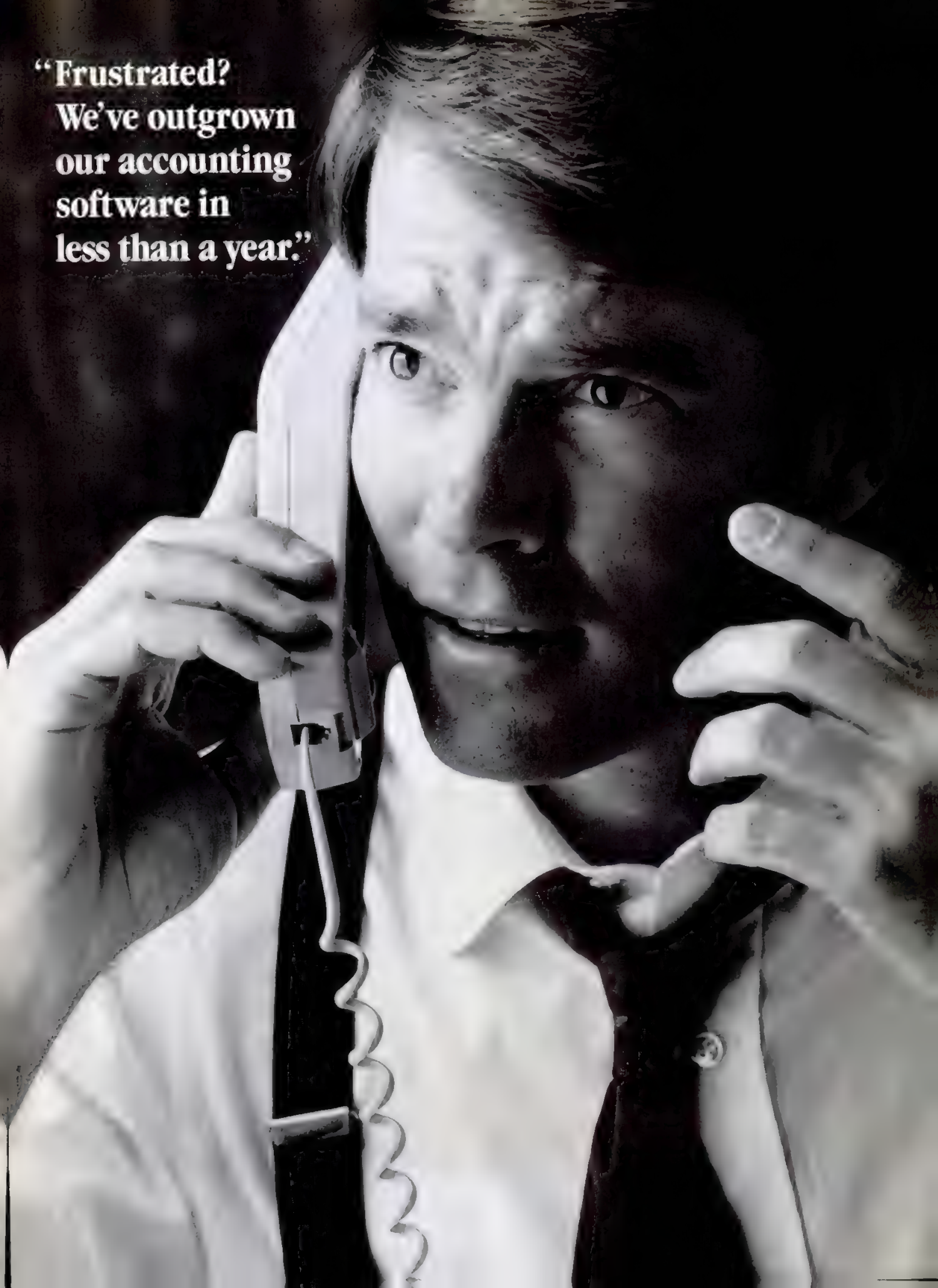
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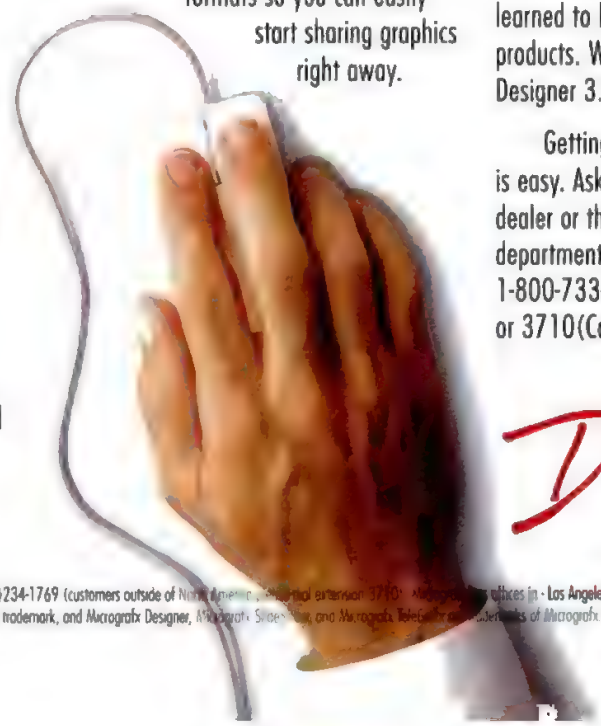

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Letters

I got a lot of useful information from your recent coverage of 1,024 by 768 video adapters and monitors (*PC Magazine*, April 10, 1990).

However, with all the increases in speed and resolution, why must we still settle for the old PC character set? Am I missing something, or is there some hidden obstacle to getting great-looking text as well as graphics from the current technology? We were able to do it in 1984; has the art been lost?

Stephen W. Roberts
La Jolla, California

WHAT YOU SEE IS WHAT WE WANT

I was really surprised at the disservice that Craig L. Stark did *Word for Windows* in his column (The Working Word, *PC Magazine*, April 10, 1990). I have been using the program extensively, sometimes putting in eight hours straight in front of the screen, and I have never experienced any of the various discomforts that he seems to experience.

I also found it strange that he didn't mention the ease with which the *Windows* screen fonts could be replaced with fonts from other providers, such as Bitstream. Whatever his problems with the fonts, I greatly prefer them to typing away in a font that has no relationship to what will be printed out. At least the line breaks will show up where they will be on the printed page.

Steve Zimmerman
San Francisco, California

While people write more often to disagree with an editorial opinion than to support it, I've been surprised to find my mail running about 2:1 in support of my complaints about the difficulty in reading *Microsoft Word for Windows* on screen. If your eyes are young (you're under 40 and you don't wear reading glasses), the extra effort required to focus for long periods may not cause you as much pain as it does me—and many others.

Mr. Zimmerman is quite right that the *Microsoft Windows*' fonts do provide WYSIWYG word processing; however, I did suggest using the Bitstream versions in the first paragraph of my April 24 column.—*Craig L. Stark*

CORRECTIONS & AMPLIFICATIONS

The full name of Panasonic's new laptop is the Panasonic CF-150BPKG Business Partner, and Panasonic's Communications and Systems Co.'s main switchboard lines are (201) 348-7000 and (800) 742-8086 (First Looks, *PC Magazine*, May 29, 1990). Additional batteries for the Business Partner are available for $29.99.

Due to a production error, incorrect upgrade information appeared in the review of *PFS:First Publisher*, Version 3.0 (First Looks, *PC Magazine*, May 15, 1990). Users who purchased Version 2.1 of *PFS:First Publisher* after February 19, 1990 will receive a free upgrade. All other users can upgrade for $45.

The correct phone numbers for the Event Horizons electronic bulletin board (After Hours, *PC Magazine*, May 15, 1990), of Portland, Oregon are (503) 697-7700 for business calls and (503) 777-1578 to access the board itself.

The correct phone number for Cykic Software (New and Improved, *PC Magazine*, April 24, 1990) is (619) 297-0182.

The correct phone number for Veridata Inc. ("286 Laptops and Portables," *PC Magazine*, March 13, 1990) is (818) 303-0613.

The benchmark table for the Microsoft BASIC PDS review (First Looks, *PC Magazine*, February 13, 1990) erroneously compared math coprocessor-aware times with coprocessor-unaware times for QuickBASIC 4.5 and Microsoft BASIC 6.0.

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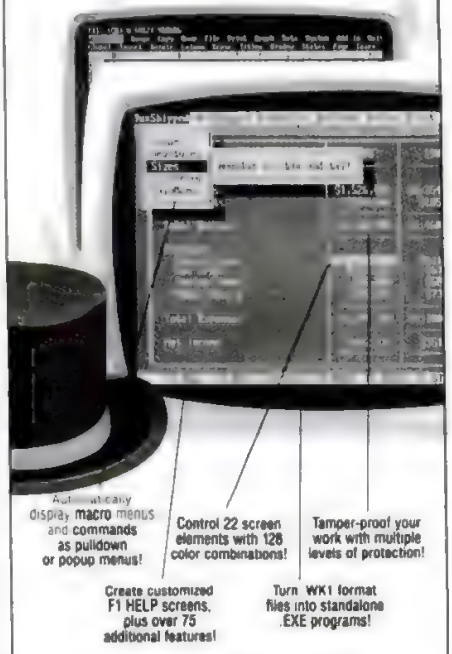

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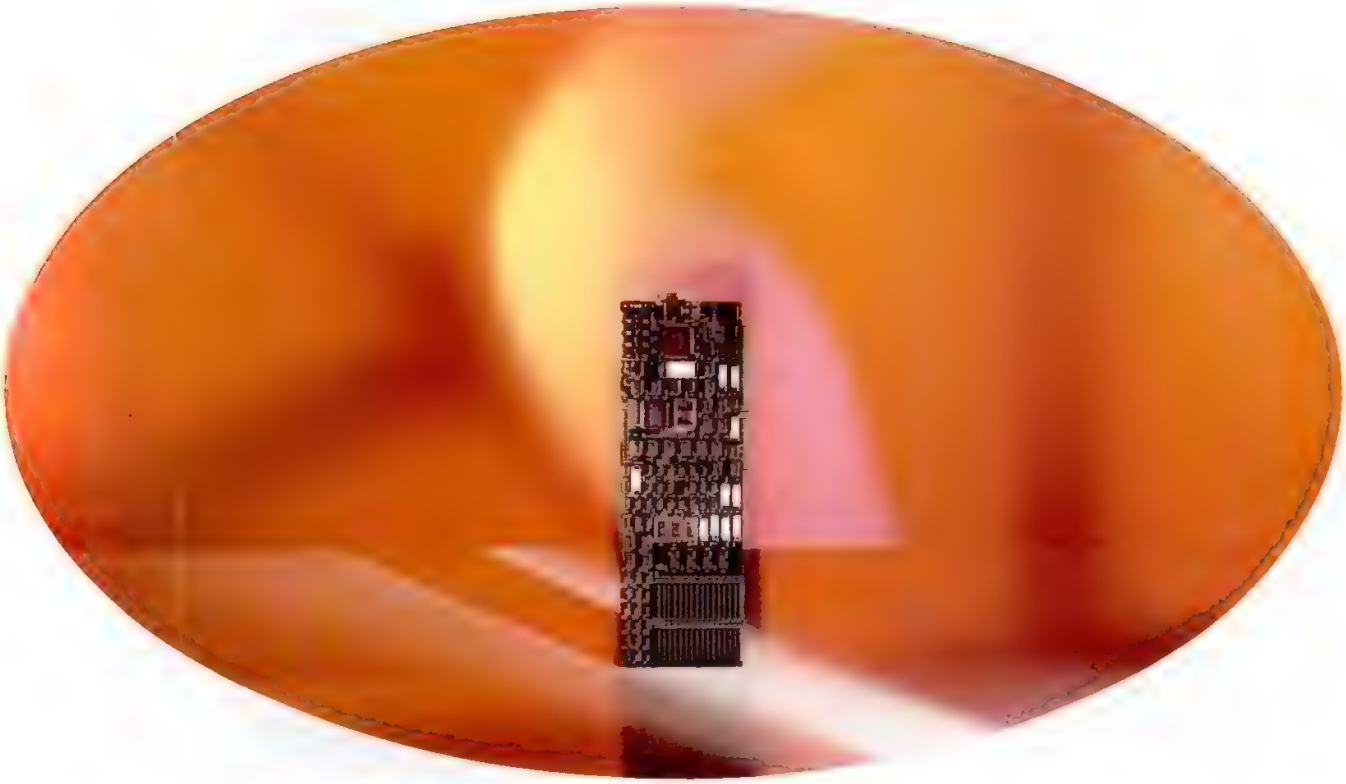

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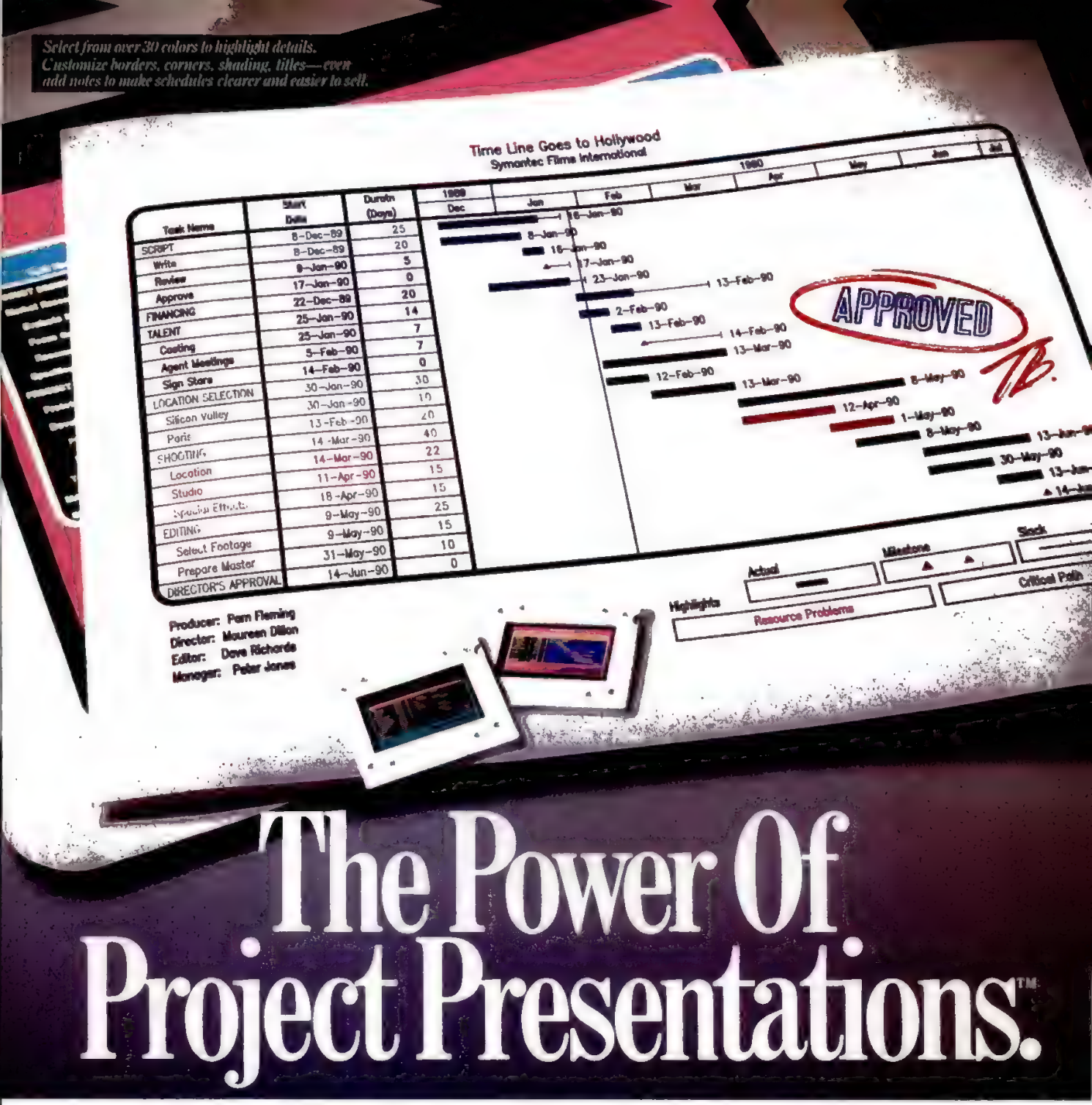

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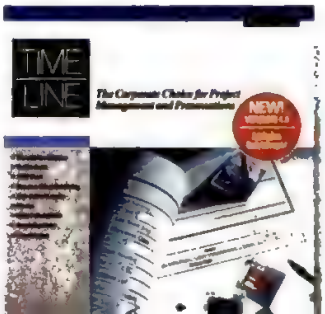

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by Lori Grunin

Advisor

- FLIPPING YOUR SYSTEM: Safely putting a desktop machine on its side.
- COLOR CONTROL: Changing your default DOS colors.
- MAKING A CONNECTION: Getting cables made to order.
- PC MAGNET IN EUROPE: Local access numbers for European users.

FLIPPING YOUR SYSTEM

Although I am very satisfied with the performance of my system, it does take up much of my precious desk space. Since I don't want to buy a new desk, I was wondering whether it is possible to put the computer on its side by the desk.

I have asked various computer and accessories' dealers whether it will be safe for the hard drive. Most said that they see no problem but said that I might have to reformat my hard disk once the computer was on its side. What really worried me is that most of the dealers politely asked me to call them once I had mounted the computer on its side and tell them if I had any problems. Most of those people had their own machines steady on their desks.

Is it safe? What are the risks?

Gil Freund
Jerusalem, Israel

I can understand your unease at the uncertainty of the dealers, but don't worry—the consensus on the issue of flipping your system is that it's harmless.

The dealers were right on target, however, about reformatting the hard drive, but note that you need to *low-level* format it, not DOS FORMAT. When you low-level format a drive, the head creates the dividers that allow it to locate the data. If you turn the computer, and hence the hard drive, on its side without reformatting, then you run the risk of head misalignment, rendering your data unreadable. Reformatting the disk in a vertical position eliminates this problem.

I also highly recommend popping into one of those accessory stores you mentioned and buying a stand specifically designed for putting a desktop machine on its side. A stand stabilizes the system and elevates it away from the dust that the fan draws into the system unit. If you share a home with a furry animal that sheds, then putting the system down near the floor may not be the greatest idea—computers aren't very good at coughing up fur balls but they're great at sucking them in.

You also might need to buy an extension cable for your keyboard. If the aforementioned merchants don't carry the extenders, you can get them via mail order from a number of places, including the firms mentioned later in this column in "Making a Connection."

COLOR CONTROL

Is there a way to change the colors on my VGA display?

Ron Young
West Hollywood, California

There are *a lot* of ways to change your screen colors, ranging from issuing ANSI escape sequences to using utilities that let you select the default colors that DOS will use from the entire VGA palette. I won't go into the ANSI.SYS solution—you can look up the instructions for using this driver in almost any DOS reference book or manual. Alternatively, you can look in the User-to-User column of the September 26, 1989, issue of *PC Magazine*, which provides the code for a small batch file, SCREEN.BAT, that implements ANSI .SYS to change colors.

One very good utility that lets you easily choose your background, foreground, and border colors is part of the Norton Control Center module of the *Norton Utilities* ($99.95; Peter Norton Computing Inc., 100 Wilshire Blvd., 9th floor, Santa Monica, CA 90401; (213) 319-2000).

Although the price is a bit steep for a simple color change, the Control Center also lets you select colors from the entire VGA palette; and, of course, you get a great set of disk utilities to boot. (For a review of *The Norton Utilities*, see "Disaster Relief: DOS Utilities Save the Day" in the March 27, 1990, issue of *PC Magazine*.) Norton's color-changing utility differs from most of the others because it separates the DOS colorset selection from the foreground, background, and border selection.

Several utilities I found on CompuServe give you the ability to remap the DOS colors, which indirectly changes the colors available at the DOS command line. The benefit of using this type of utility is that it allows you to select different colors for your applications—even a dull *Lotus 1-2-3* spreadsheet. These programs can all be downloaded from Data Library 3 of the IBMHW forum on CompuServe.

They include the free COLORS (filename: SETCOL.EXE); Video Palette Tool ($20; filename: VPT350.ZIP, also available from clySmic Software, P.O. Box 2271, Empire State Plaza, Albany, NY 12220); VPAL (free; filename: VPAL.ARC, requires a mouse); and VGACOLOR ($10; filename VGACLR .ARC). These are all interesting programs that let you experiment with and learn about DOS color usage, and since they're shareware, you can try them out before you decide to either keep them or go with a more prettily packaged product.

Finally, we come to *UltraVision* (see page 48 of *PC Magazine*, May 29, 1990), a great display utility that gives you a choice of screen fonts—that stick within applications—in addition to color controls. (*UltraVision*, $120; Personics Corp., 63 Great Rd., Maynard, MA 01754; (800) 445-3311; (508) 897-1575.)

MAKING A CONNECTION

I need a cable to connect an RF (Radio Frequency) modulator and a TV monitor, and a cable to run from the computer's composite card to an RF modulator. Could you be so kind as to recommend a custom cable supplier that would make these cables for me?

Vera Komarkova
Leysin, Switzerland

I'm assuming that you know for sure that you need custom cables, and that the solution is more complex than running into the local Radio Shack (or the Swiss equivalent) and getting an adapter to convert, for example, a coax connector to an RCA jack.

Some mail-order office-computer supply companies will also do custom cabling; one example is Inmac (2465 Augustine Dr., Santa Clara, CA 95054; (800) 547-5444, (408) 727-1970. If you submit a written request for a catalog, be sure to include your phone number).

There are also quite a few mail-order firms that specialize in connectivity-related hardware, including Cables & Chips (121 Fulton St., New York, NY 10038; (800) 843-4117, (212) 619-3132) and Black Box Corp. (P.O. Box 12800, Pittsburgh, PA 15241; (412) 746-5500). Tell them the desired cable type, pinout configuration, and connector type and they make the cable of your dreams.

Sometimes the catalogs distributed by cable suppliers are just nice to have on hand; Black Box's, for example, contains valuable connectivity-related definitions and pinout configurations for popular cables.

PC MAGNET IN EUROPE

There are rumors in Belgium that your Bulletin Board System, PC MagNet, is also installed in Europe. Is this true?

J. Bruyndonckx
Herentals, Belgium

I'm impressed—you found out about it before I did! Actually, CompuServe Information Service (CIS) has introduced new local access numbers using the Istel, Telepac, and CSC networks for the United Kingdom, Belgium, Denmark, Finland, France, Italy, The Netherlands, Norway, Spain, Sweden, Switzerland, and West Germany.

If you're already a CIS member, you can get the access numbers on-line (GO EUROPHONES). Otherwise, you can get in touch with one of the CIS Customer Service offices in Europe (inside UK—Bristol 0800 289 458, outside UK—Bristol 0272 255111, rest of Europe—Switzerland (41) 31-509 800).

ASK THE ADVISOR

Send your questions to Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column for access information). Please specify your equipment. ■

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CIRCLE 276 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

IBM's PS/1 Removes the Hassles and Delivers Decent Performance for Beginners

HANDS ON by Gus Venditto

This is *not* the kind of machine you expected to see on the cover of *PC Magazine*.

80286-based PCs have been studiously ignored by the magazine's editors since September, 1989, when we published our last roundup of entry-level 286s. But anyone who ignores the PS/1 today will miss the biggest effort ever mounted to conquer computing's last great frontier—the home.

The PS/1, whose models range from $1,000 to $2,000, is a system designed to solve the problems that have kept millions of Americans from buying a home PC. Rejecting the conventional wisdom guiding virtually every computer project, IBM built a machine driven by the market, rather than technology—a machine that *doesn't* require hours of configuration, *doesn't* force a whole new vocabulary on the casual computer user, and *doesn't* put too serious a dent in the budget.

The PS/1 is designed to be as easy to buy, use and maintain as a microwave oven. IBM plans to support it with banks of 800-number technicians, and two separate on-line services. If there's a mechanical failure, IBM says it will immediately dispatch an overnight shipment with the part or unit.

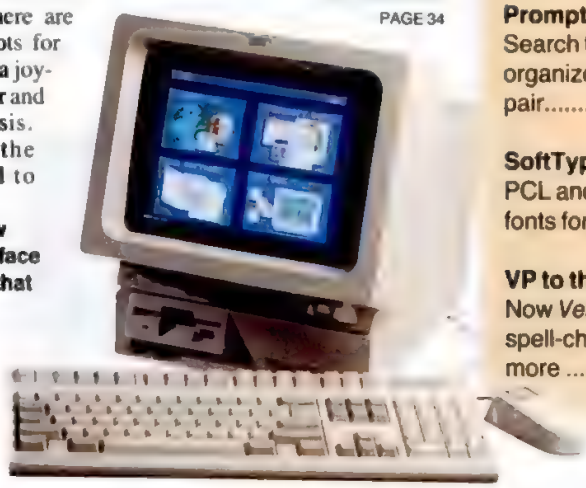
That's right. You *don't* go back to the store, you call IBM. IBM promises to answer the phone and actually help the owner of a personal computer solve a mechanical problem.

The PS/1's design lends itself to this kind of service. The base unit is a mere 10 pounds, and is not much larger than a DOS manual box.

The machine will never make a power user happy. Upgrade options are severely limited. In miniaturizing the PS/1 footprint, IBM left out the expansion slots. There are three proprietary slots for additional memory, a joystick, a MIDI adapter and an expansion chassis. However, even the chassis is limited to three AT-bus cards. On the other hand, the machine comes equipped with on-board VGA, a mouse port, an internal 2,400-bit-per-second Hayes-compatible modem, 3.5-inch 1.44MB floppy drive, and a parallel port. A mouse comes standard with all models.

There's no power supply inside the chassis. It's housed in the monitor, so that two cables

CONTINUES ON PAGE 34



IBM designed a new mouse-driven interface for the PS/1 family that guides you to executable files. It's easily eliminated in favor of the DOS prompt or DOS 4.0 shell.

PC AUGUST REVIEW INDEX

Microsoft PowerPoint
Presentation graphics for *Windows* 3.0 43

Turbo C++
Borland earns an A for its newest language .. 36

Prompt and Dragnet
Search text and organize files with this pair 38

SoftType
PCL and PostScript fonts for *Windows* 46

VP to the Max
Now *Ventura* has a spell-checker and more 49

Harvard Graphics 2.3 Integrates Draw Partner and Adds HyperShow

HANDS ON by Lillian Simonds

There is no denying that *Harvard Graphics* is facing some fierce new competition, most notably in the form of Microsoft's *Windows*-based *PowerPoint* (also reviewed in this issue). But, instead of the roar one would expect from the king of the presentation graphics hill, Version 2.3 speaks in hushed tones. The new features in this latest version of Software Publishing Corp.'s, $495 best-seller include tighter integration with Draw Partner, built-in sample charts, and the ability to create hyperlinks between slides in a Screen Show.

A HyperShow is easy to create, and cashes in on some of the excitement surrounding true hypermedia presentations, but it is ultimately very limited. The two-step creation process requires that you use either Draw/Annotate or Draw Partner to create a hyper button in a slide, and then assign a link to the button in the Options portion of the Screen Show Effects menu.

Though the hyper button itself is always invisible, you can create a visible button either by overlaying a box created with the program's graphics primitives, or by importing a piece of clip art. Each screen slide can have ten user-defined buttons, as well as seven predefined buttons (such as a Home button which will return you to the first slide in the presentation). At show time, buttons are invoked by either a hotkey or via a mouse click on the button itself. The size of the button is crucial to success—small buttons don't work well.

Harvard's hyperlinks are unidirectional. The only way to travel back and forth between two slides is to manually insert a second backward link. In addition, *Harvard* cannot accommodate the logic structures, such as conditional or timed loops, necessary for true hypermedia presentations.

Power users of *Harvard*

CONTINUED ON PAGE 35

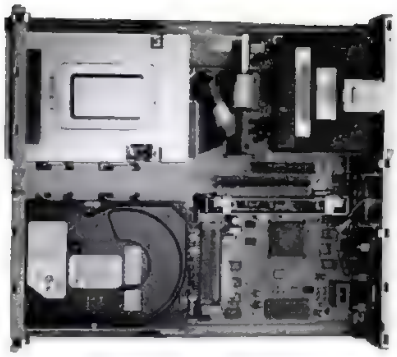
CONTINUED FROM PAGE 33

run between system and display. This design makes it possible to have a single AC socket and on/off switch.

IBM VS. TANDY

IBM may have been too quick to crimp the upgrade plans of its PS/1 owners, but it's convinced that the typical family-oriented buyer is more concerned with size and cost than expansion. To determine whether the PS/1 is really a good value, I compared the top-of-the-line model with a comparably configured $2,100 Tandy 1000TL/2.

It was impossible to match the configurations exactly. In order to compare machines that cost roughly the same, we had to use a Tandy with a smaller hard disk (20MB instead of 30MB). The Tandy also uses a slower 80286 chip (8 MHz instead of 10 MHz), and a slower hard disk (70-millisecond average access time instead of 23 ms.). The Tandy's Super CGA level display doesn't hold up well next to IBM's VGA, and the standard 3.5-inch disk on the IBM is high density, while Tandy economizes with low density.



No screwdriver is needed to get inside the PS/1 CPU. The face plate pops off and the cover slides off.

Both give you a parallel port. IBM has a built-in modem but no serial port. Tandy has a serial port, but the mouse claimed it in our test configuration. By this count IBM provides a better port configuration (assuming you'd add a mouse and a modem to the Tandy).

In Tandy's favor, the sound facility (using a proprietary chip) is standard, with the microphone and earphone jacks right on the front panel. IBM's MIDI option will cost $249 when it ships later in the year. And, Tandy gives you two joystick ports; IBM offers one, and only when you buy the MIDI option.

The keyboards use exactly the same layout; both are full 101-key keyboards with good tactile response. IBM's is lighter, which may be more appealing to parents of small children.

Both systems shield new users from the DOS prompt with their own auto-booting shell interface. They also both give you the option of bypassing these opening menus in favor of DOS.

IBM is likely to win big with its PS/1 interface, especially with new users. This truly is a user-friendly, clean face. Using a mouse, you can find your way to software in a matter of seconds. In contrast, Tandy's *DeskMate* interface suffers because it feels cluttered with a grabag of commands, some useful, some rarely needed.

The PS/1 will put you into DOS 4.0 as one of its four basic options, or it will guide you into applications through a painfully obvious system. Since the DOS system kernel resides in ROM, frightening "non-system disk" errors will never be a problem. The system also comes with a tutorial at the "this-is-a-floppy-disk" level.

The menu shell conveniently steers users into Prodigy, the on-line service IBM co-owns with Sears. The match between a PS/1 and Prodigy is apparent: anyone who is attracted to Prodigy's boldly graphical menu choices will be right at home with PS/1's similar style. IBM plans to provide product support via Prodigy, but it has also established a separate PS/1 on-line service, called Promenade, that's run by Quantum Computer Services and comes preinstalled on hard disk models.

The healthy amount of software on the hard disk (*Microsoft Works* is also installed) and the ease of getting started with the hard disk-equipped models, make them a far better buy. In fact, if you choose to recommend a PS/1 to someone you hope to remain friendly with, steer them away from the floppy-based machines. The hard disk is fast and well worth the extra cost. Initially, IBM will sell PS/1s only in Dallas, Chicago, and Minneapolis but plans national distribution in time for Christmas.

The PS/1 line includes four models that use the same 10-MHz 80286, but differ in display resolutions, hard disk configuration, and RAM. The $999 base model has 512K of RAM, no hard disk and a VGA monochrome monitor (IBM calls this a "PhotoGraphic" display, but it's just a marketing slogan for a standard monochrome VGA display). The next model supports color VGA, and lists for $1,499.

The lowest-level hard disk model is the same as the base model, but it has a 30MB hard disk and 640K of RAM; the list price is $1,699. The $1,999 top-of-the-line machine has a full

BENCHMARK TESTS: IBM PS/1

PC LABS

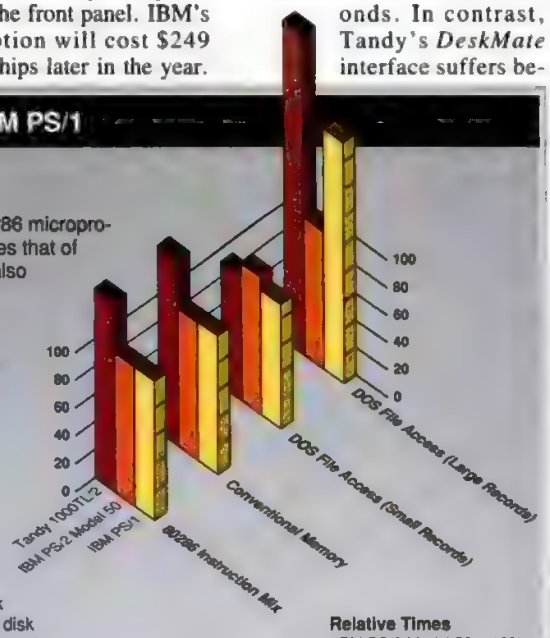
IBM PS/1's performance, with its 10-MHz 80286 microprocessor and 23-millisecond hard disk, surpasses that of the Tandy 1000TL/2, a similar system that's also targeted at the home market.

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



Performance Times

(Times given in seconds)	80286 Instruction Mix	Conventional Memory	DOS File Access (Small Records)	DOS File Access (Large Records)
Tandy 1000TL/2	9.87	1.52	89.85	28.00
IBM PS/2 Model 50	7.21	1.13	99.04	12.07
IBM PS/1	7.18	1.13	89.75	21.01

640K of RAM, a 30MB hard disk and color VGA.

These aren't bargain prices if you're familiar with companies like Zeos, Gateway, and Northgate, and appreciate the 386SX machines they sell for $2,000.

And competition for the home market is mounting from other quarters, such as the CD-ROM-equipped Vendex Headstart and Fujitsu's FM-Townes systems. But if you compare it with a direct competitor—Tandy's 1000TL/2—the price holds up pretty well.

No, the PS/1 isn't a system for the *PC Magazine* reader; but it may be a system you can comfortably recommend to your next-door neighbor.

And it's certainly easy to find conceptual flaws with the PS/1. The monitor shouldn't house the power supply. And, the monitor is too heavy and needs a swivel-tray.

Still, it's hard to condemn a machine that comes with such noble intentions. IBM did the important things right: it delivered the best of today's standards at a reasonable price. If IBM has correctly identified the hassles that make most Americans shy away from a PC, the two hard disk-equipped PS/1's will become runaway best-sellers. They deliver no-hassle computing for beginners. And that's saying a lot. ■

FACT FILE

Personal System/1
IBM Corp; contact an authorized IBM dealer for information, or call (800) IBM-2468
List Price: $999 without hard disk, with black-and-white VGA; $1,499 without hard disk, with color VGA; $1,699 with hard disk and black-and-white VGA; $1,999 with hard disk and color.
In Short: A bold attempt to reach America at home, this 10-MHz 286 has VGA and a simple mouse-driven interface.

CIRCLE 669 ON READER SERVICE CARD

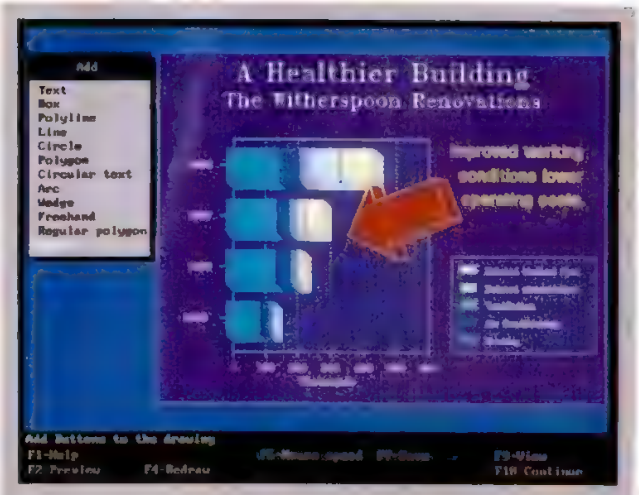
CONTINUED FROM PAGE 33

Graphics will rejoice in the newfound integration between the main program and the enhanced drawing facility, Draw Partner. Draw Partner provides sophisticated effects such as skewing, rotating, and point editing objects, but in the past, you had to exit from *Harvard* to access it. Now, you can invoke Draw Partner from within *Harvard*, either through *Harvard*'s new application shell or by using one of the seven new speed keys. The Applications shell lets you invoke Draw Partner, or any other DOS application that you designate, allowing you to run your word processor or DOS utilities while *Harvard*'s current state is saved to either a RAM or hard disk.

Using the hotkeys, Ctrl-D automatically loads Draw Partner, and brings up the current chart. You no longer have to save a chart as a symbol before bringing it into Draw Partner. This means you can make extensive visual annotations to a slide, and still edit the underlying data. Treating the data and drawing as a unit is a feature that is implemented more thoroughly in new object-oriented programs like *PowerPoint*, but *Harvard Graphics* still beats out major competitors (such as Lotus's *Freelance Plus*) that require you to lose the links to your data, and convert a chart to a drawing before you add design elements.

The new version helps novices by adding sample charts to the Chart Gallery. Now you can select from various on-screen thumbnails, and then segue to that chart's data entry form. Other new shortcuts include a single keystroke to get, save, and print charts, as well as the ability to use a hotkey to access the *Lotus 1-2-3*, and (finally!) *Microsoft Excel* data import screens. These hotkeys save you from the endless shuttle between the chart entry screen, the main menu, and the worksheet import screen and are a major improvement. However, *Harvard* still provides no interactive access to worksheets.

Ten sample sprite-like objects, created in Draw Partner, add primitive animation to the screen. The animated sequences take advantage of the fact that *Harvard* redraws screens from back to front. By cleverly overlaying objects in a drawing you can produce animation-like effects.



The new version of *Harvard Graphics* lets you bring a chart into Draw Partner (shown here) where you can add symbols like the arrow, enhance text, and—most importantly—draw hyperlink buttons (see the highlighted menu choice).

Another improvement that may prove problematic is the upgraded 500-item symbol library. As we went to press, Software Publishing and Computer Support Corp. (makers of the *Arts and Letters* clip-art library) were entering into litigation over the copyright on these images.

Legal dilemmas aside, *Harvard Graphics* remains, in most ways, unchanged. On some levels that's good news. *Harvard* still runs on the spectrum of PC platforms, has a more than adequate 240 data point maximum; a built-in spell-checker; chart types that include regression analyses, log-log plots as well as the more standard charts, and extensive film recorder support.

Harvard's reputation as the easiest to use charting program on the market is in danger. The user interface, which was once a model for ease of use, has been stretched out of shape to accommodate new functions. Function keys, for example, confusingly invoke different features depending upon your location within the program.

Users who wish to advance beyond the program's simple charts and presentations will soon find the interface confining, and the drawing and importing functions limiting. However, for those users who have already invested heavily in *Harvard*-based presentations, this $75 upgrade can provide the tweaked performance that will extend the life of their presentations, and this product. ■

FACT FILE

***Harvard Graphics*, Version 2.3**
Software Publishing Corp., 1901 Landings Dr., Mountain View, CA 94039-7210; (415) 962-8910.
List Price: $495, upgrade $75.
Requires: 512K RAM, hard disk, graphics adapter, DOS 2.1 or higher.
In Short: Version 2.3 allows users to more easily annotate drawings by providing tighter integration between itself and its drawing facility, Draw Partner. In addition, the ability to create a HyperShow helps to communicate complex information.

However, many long-standing weaknesses of the program, including limited data import, poor support of VGA and extended VGA, and a user interface that's been stretched out of shape to accommodate new features, remain frustrating.

CIRCLE 668 ON READER SERVICE CARD

Turbo C++: Everything You Always Wanted in a C Compiler and More

HANDS ON
By Richard Hale Shaw

Despite movement toward standardization, products from vendors like Zortech and Glockenspiel, and interest in object orientation as an application-development solution, most developers have remained on the C++ sidelines awaiting a major offering to "legitimize" the C++ market for DOS programmers. Fortunately, the wait is over.

Borland's Turbo C++ 1.0 Professional fully implements the AT&T C++ 2.0 standard. With a redesigned integrated development environment (IDE), Turbo Tools, and VROOMM overlay support, the $299.95 package may be the only tool you'll ever need to enter the world of object-oriented programming under MS-DOS.

Turbo C++'s IDE is not just an improvement, but a skillful redesign of Turbo C's. While still character-based, it uses a desktop metaphor with system menu icons; full CUA compliance includes scroll-bar-framed overlapping windows that are movable, sizable, and mousable. You can open a different file in each window, and use the Clipboard to cut-and-paste text from any window—including the on-line help, which offers hypertext hotlinks between topics.

The Editor now features TEML, a programmable macro language, while a Transfer option lets you add programs to the interface, direct their output to a Turbo C++ window, and set their memory allocations. Finally, the Project Manager lets you select files from list boxes, choose a tool to build each program module, and automatically create dependency lists. In all, the IDE looks and feels slick, fast, and responsive—as well as being wonderfully intuitive. It's the first interface that didn't leave me pining for the command line version.

Borland's VROOMM technology allows you to take advantage of EMS and extended memory overlay swapping. In addition, Borland includes its Turbo Tools—the new Turbo Profiler, Turbo Assembler 2.0, and Turbo Debugger 2.0. The Debugger's support for C++ classes and the ability to reverse or undo program execution make it an especially welcome part of the package. Even if you don't plan to move from C to C++, it's worth moving to Turbo C++ Professional for these features alone.

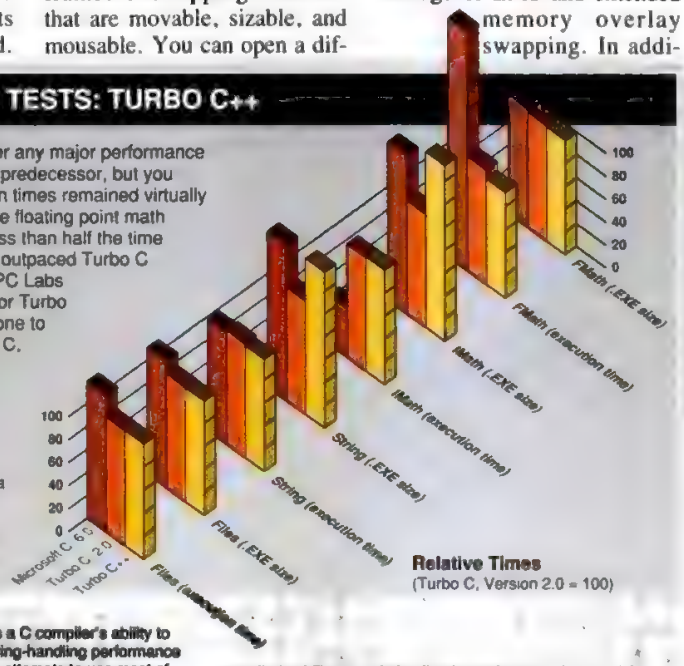
Unlike Zortech C++ or Microsoft C, Turbo C++ doesn't let you create applications for *Microsoft Windows*, nor does it compile OS/2 applications. You can run it under *Windows* 3.0, but you can only receive mouse input in full-screen mode. And while it includes an excellent C++ Primer and full source code for the class libraries, there are still too few practical C++ examples provided.

What's the bottom line? If you need to compile *Microsoft Windows* or OS/2 applications today, you will have to look elsewhere. If you are already using Turbo C, you can't lose by making the move to Turbo C++ Professional. But if you want an excellent ANSI compiler with integrated environment, overlay linkage, profiler, assembler, and an award-winning debugger—not to mention C and C++ support—look no further: Turbo C++ Professional is here. ■

BENCHMARK TESTS: TURBO C++

PC LABS

Turbo C++ doesn't offer any major performance improvements over its predecessor, but you won't be disappointed. Execution times remained virtually identical with the exception of the floating point math test, in which Turbo C++ took less than half the time required by Microsoft C 6.0 and outpaced Turbo C 2.0 by almost ten percent. The PC Labs benchmark test Compile times for Turbo C++ (not shown) tended to run one to four seconds slower than Turbo C, largely due to the overhead imposed by ANSI-compliant type checking and loading the C++ preprocessor.



The **Files** benchmark program tests a C compiler's file-handling abilities. A compiler's level of performance on this test results both from its ability to optimize file-handling code and from the file-handling efficiency of its runtime library.

The **String** benchmark program tests a C compiler's ability to optimize string operations and the string-handling performance of the routines in its runtime library. It attempts to use most of the string operations found in a typical C program.

The **IMath** benchmark program tests a C compiler's ability to optimize standard integer math operations. The test attempts to simulate the integer math operations performed in a variety of C program contexts.

The **FMath** benchmark program tests a C compiler's ability to generate optimal floating-point math code, based on the compiler's ability to optimize floating-point operations and the efficiency of its floating-point library routines.

All tests were performed on a 16-MHz Zenith 386 with a 3MB RAM disk. The compiled programs were run from the RAM disk, and both the RAM and the hard disk were optimized between each set of tests. Each of the compilers was optimized for speed. For a complete description of the PC Labs C Compilers benchmark tests, see *PC Magazine*, September 13, 1988, pages 162 to 164.

Performance Times
(Times given in seconds; .EXE size given in kilobytes)

	Files		String		IMath		FMath	
	(execution time)	(.EXE size)	(execution time)	(.EXE size)	(execution time)	(.EXE size)	(execution time)	(.EXE size)
Microsoft C 6.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Turbo C 2.0	40.82	30.73	24.59	3.90	56.09	2.82	60.44	23.82
Turbo C++	40.82	30.59	24.03	5.33	56.22	4.34	55.75	23.62

PC MAGAZINE

FACT FILE

Turbo C++ 1.0 Professional
Borland International, 1800 Green Hills Rd., P.O. Box 660001, Scotts Valley, CA 95067; (408) 438-8400.
List Price: $299.95; $199.95 without Turbo Tools.
Requires: 640K RAM, hard disk, DOS 2.0 or later. Mouse recommended.
In Short: A complete ANSI Standard C compiler that fully supports AT&T C++ 2.0. It has an excellent integrated development environment and solid performance. The VROOMM overlay linkage and Turbo Tools alone make it worth the price of the package. A must for every C++ programmer.

CIRCLE 432 ON READER SERVICE CARD

Scalable LaserJet Fonts for WordPerfect

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Letter Gothic **Copperfield** Garamand Corporate Condensed Carnegie
Baskerton Classic Typewriter Obelisk **Gettysburg** Futuri
Avant Guard **Aero** GREEK AB$∫ 01 Exchequer Script Katrina
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CIRCLE 299 ON READER SERVICE CARD

Prompt and Dragnet: Windows-based Dynamic Duo for Organizing Text and Searching

HANDS ON
by Barry Simon

Here a shell, there a shell, everywhere a DOS shell. Seems that everywhere you look in the software barnyard, you see yet another program that fits somewhere into a genotype of DOS shell, hard disk manager, or file organizer. But within the *Microsoft Windows* environment, if you want the kind of power that you get from *PC Tools* or *Norton Commander*, your best choice is the $130 *Prompt* from Access Softek.

Prompt gives you some intelligent file management capabilities that were left out of the *Windows* File Manager (called FileMan), and also includes some niceties—such as file viewers—that *Pubtech File Organizer* and *Command Post* (which we'll review in an upcoming issue) lack.

Prompt has all of the file organizing basics and much more. It allows you to copy and move files by dragging between windows just as you can with FileMan. However, unlike FileMan or most DOS shells, you can also copy or move entire directories—even between disks. When you drag files to a different location, *Prompt*'s icon lists the number of files you are dragging, rather than just displaying FileMan's pretty but non-utilitarian icon.

The disk drive icons in *Prompt* indicate the percentage of the drive in use, and in the tree view you can turn on a bar graph of directory usage. And what's that in the corner? Oh no, not another trash can! But wait—this is no ordinary receptacle, it's a macho garbage pail which can erase files and entire directories.

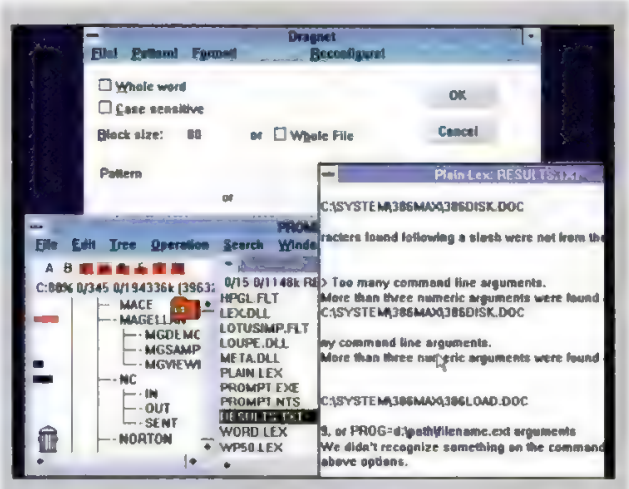
Another big advantage *Prompt* has over FileMan is that you can configure the program to remember the trees and directories that were open when you last ran the program, and to reopen them the next time you begin another session.

Unfortunately, *Prompt* has not addressed one of FileMan's biggest problems—the time it takes to read the tree of a large hard disk every time the program starts. Many DOS shells—*QDOS*, *Norton Commander*, and *Tree86* come to mind—keep a copy of the tree on disk for instant start-up; *Prompt* would do well to emulate them.

The program also became somewhat confused by a drive letter created using the DOS SUBST command.

Prompt has a fair number of specialized file viewers. It is strong on graphics files: the program ships with viewers for .CGM, Micrografx .DRW, Lotus .PIC and HPGL. Although viewers for .PCX and TIFF weren't available with the first shipping copies of the software, they have been promised to all registered users.

There is also support for *Lotus 1-2-3*, *Microsoft Excel*, and *dBASE*, *Microsoft Word*, *WordPerfect*, and *Windows Write*. But there is no Hex viewer or support for *Word for Windows* or *Ami Professional*. Moreover, while it uses the same viewers as *Dragnet*, (Access Softek's sophisticated text search program) which can find text in .DRW files, *Prompt* cannot display small point-size text.



Prompt organizes files; Dragnet searches them. Here we see Dragnet's pattern dialog, Prompt's shell, and a viewer displaying the results of a search.

From the text, spreadsheet, and database viewers, you can copy text to the clipboard for pasting into applications. As in FileMan, you can launch an application from *Prompt* by double-clicking. But *Prompt* does not allow you to launch an application by dragging a data file icon to an application icon the way FileMan does. Also, unlike FileMan, keys like Home/End do not work in trees—*Prompt* requires you to mouse around.

While *Prompt* can speedily find a given filename, it totally lacks any method for searching within files—you can't even search within a straight text file. Instead, Access Softek wants you to shell out $145 for *Dragnet*. With this tandem strategy, you'll use *Dragnet* to find the files you need, and then *Prompt* to reorganize them.

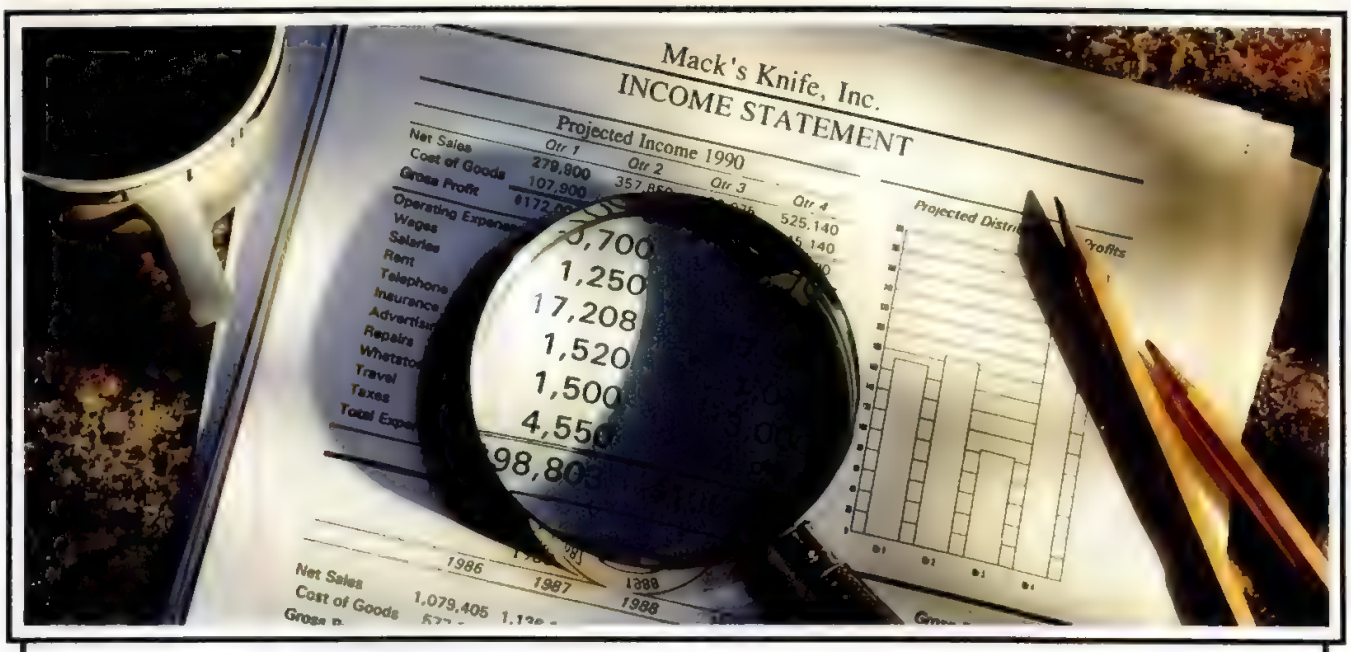
When released in 1986, *Dragnet* 1.0 was one of the earliest *Windows* applications and one of the first text-search programs. The current release gives you considerable flexibility. You can search single directories, a branch of a tree, entire drives, or a single filespec across all drives; each search query can have a single Boolean "AND" with up to three Boolean "ORs." When searching with a Boolean "AND," you can look for the two phrases within a specified number of characters. The output is directed to a file, the screen, or the clipboard. If you have *Prompt* you can use a DDE (dynamic data exchange) link to direct the names of the files with matches to *Prompt*. *Dragnet* supports both background and interactive operation.

Since *Dragnet* doesn't index your disk, its searches are slower than *Lotus Magellan*'s—but not by that much. On an informal test search of 66 files comprising 3MB of text, a simple search took *Magellan* 7 seconds and *Dragnet* 22. Even a search of 248 files containing a lot of matches spread across 3 drives took only 5 minutes.

Some users will probably still prefer using their favorite DOS shell in a window, awaiting the avalanche of *Windows* file organizers that should start appearing in about six months. But Access Softek set quite a high standard for object-oriented file management with *Prompt* and *Dragnet* that many *Windows* users will want in their utility toolkit. ■

List Price: *Prompt*, Version 2.0, $129.95. *Dragnet*, Version 2.1, $144.95. **Requires:** 512K RAM, *Microsoft Windows* 2.11 or 3.0. *Prompt* requires a mouse; a mouse is recommended for *Dragnet*. Access Softek, 3204 Adeline St., Berkeley, CA 94703; (415) 654-0116.

CIRCLE 666 ON READER SERVICE CARD



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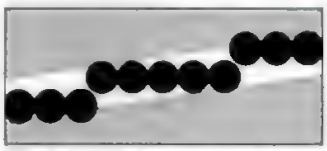

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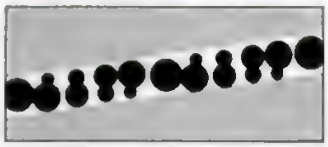

HP Resolution Enhancement smooths rough edges by varying dot size and arrangement

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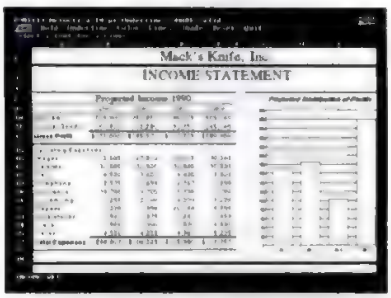

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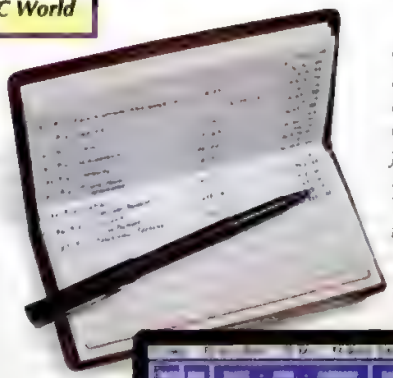

Quicken's screens look and work just like your paper checkbook. You fill in the same information. There's nothing new to learn.

QUICK START CARD

Follow these steps to be up and running with Quicken in just a few minutes.

Installing Quicken

This is an important step—don't try to skip it.

If you have a hard disk, the INSTALL program creates a subdirectory called \QUICKEN3 and copies the correct Quicken files into this subdirectory.

1. Start your computer as you usually do.
2. Insert the disk labeled **Quicken Help disk** into drive A. At the A> prompt, type **INSTALL** and press [↵] (the Enter key).
3. Follow the simple instructions that appear on the screen.

If you are not installing to a hard disk, the INSTALL program makes a working copy of your original Quicken disks and prepares a disk for your Quicken data. Have two formatted 5 1/4-inch disks or one 3 1/2-inch disk ready before you begin.

Starting Quicken

If you have a hard disk, at the root directory (type **CD** to get there) type **Q** and press [↵] to start Quicken.

If you don't have a hard disk, make sure your working copy of the Quicken Program disk is in drive A. If you are using 5 1/4-inch disks, also put your **Quicken Help/Data disk** in drive B. Type **Q** and press [↵] to start Quicken.

The Quicken Main Menu appears. That's all there is to it! You're ready to use Quicken.

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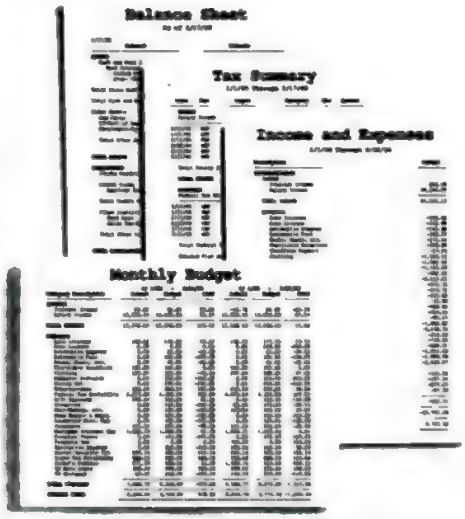

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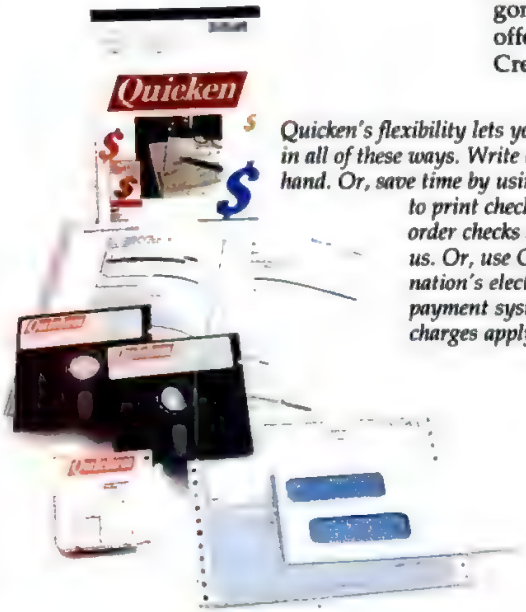

Quicken's flexibility lets you pay bills in all of these ways. Write checks by hand. Or, save time by using Quicken to print checks — you can order checks directly from us. Or, use CheckFree, the nation's electronic bill payment system. (Extra charges apply.)

☐ **YES!** Please send my risk free copy of Quicken. Charge my credit card $8 (not refundable) to cover air shipping and handling. If I don't notify you in 30 days, bill my card the $51.95 balance and I will receive my two free software packages. (CA residents pay sales tax.)

☐ **Send My Bonus Now!** Charge my credit card the full amount ($59.95) now, and send me Quicken along with two free software packages, Instant Presentations and Reminders!™ I may return everything for a full refund within 30 days if I am not satisfied. (CA residents pay sales tax.)

Name _____
Address _____
City _____ State _____ Zip _____
Daytime Phone (____) _____
IBM: ☐ 5 1/4" disk ☐ 3 1/2" disk
Credit Card Payment Method (check one):
(No purchase orders, checks, or C.O.D., please)
☐ VISA ☐ MasterCard ☐ American Express
Card No. _____ Exp. Date _____
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The page recognition software that's unmistakably accurate

When it comes to hand scanning, there's no better judge of character than ReadRight Personal.

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Not only does new ReadRight Personal automatically recognize just about every font known to the business world, it reads them with up to 99.5% accuracy. Whether the text is typewritten, typeset, NLQ, draft dot matrix or laser printed.

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What's more, ReadRight Personal understands layout and text attributes—like boldface and underlining. It also reads columns, lists and tables. Detects paragraphs, indents and tabs. And reads multiple columns and fonts on a single page.

So now you don't have to think twice about the format your text is in. Or how well it will fit in your favorite software application.* ReadRight Personal places the information you need, where you need it, with unmistakable accuracy.

SYSTEM REQUIREMENTS:
- 640K RAM
- Hard disk
- IBM PC or compatible
- DOS 3.0 or higher
- Logitech ScanMan and ScanMan Plus; The Complete PC Half-Page Scanner 400; DFI Handy Scanner 3000 Plus; Marstek 105 and 128 hand-held scanners. (Other hand-held scanners supported by importing image files.)

OCRSYSTEMS

OCR Systems, Inc.
1800 Byberry Road, Suite 1405
Huntingdon Valley, PA 19006
215-938-7460

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*ReadRight Personal reads and converts text for direct use in most popular software applications, including WordPerfect,® Microsoft® Word, Lotus® 1-2-3, Excel, dBase,® PageMaker® and Ventura Publisher.®

CIRCLE 362 ON READER SERVICE CARD

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Microsoft PowerPoint: Windows' Version of Mac Classic Adds Charting Power

HANDS ON
by Robin Raskin

For the past few years, I've watched as my Mac colleagues created presentations using Microsoft's *PowerPoint*. Now, a *Windows*-based port of that package brings the direct-manipulation approach to presentation graphics creation on the PC. By fall we expect to see other *Windows* 3.0-based presentation graphics programs vie for their rightful places on the Program Manager; for the moment, *PowerPoint* reigns alone.

Unlike programs that create presentations on a frame-by-frame basis like *Harvard Graphics* and *Freelance Plus*, *PowerPoint* incorporates tools that allow you to treat presentations as a single entity more easily. The Slide Master lies at the heart of the program's "push for consistency." A Master consists of information that is common to each slide (frame) in a presentation, such as a title, color scheme, background, border, or company logo. The Master can then be applied to all slides in one fell swoop.

Coupled with the Master approach are designer templates—sets of slides that contain consistent design elements and background information. A single template might have six or seven layouts, including bullet charts, tables, and two-column text charts. Graph templates that aid chart design work in a similar fashion. You can open any template as an untitled presentation.

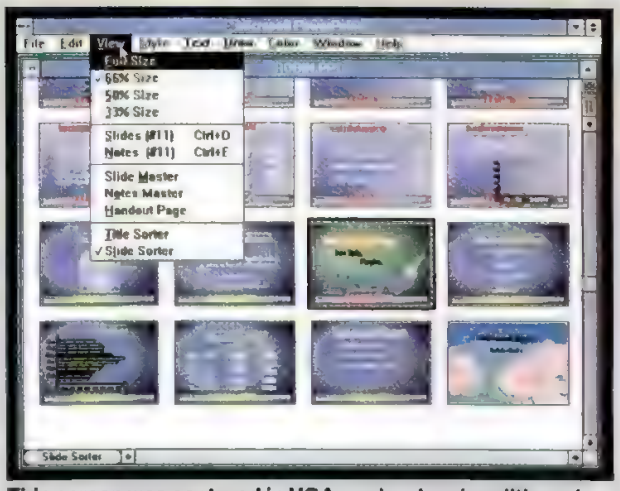
You can quickly generate speaker's notes and audience handouts to accompany a presentation. The Note View displays a miniature of a slide with room for annotations. The Audience Handout can be formatted to contain two, three, or six frames per page. The notes and handouts update automatically. Because you can have multiple output devices for a given presentation, you can easily create a color slide show with no surprises in your black-and-white handouts.

When you're ready to nail down the presentation sequence, *PowerPoint*'s Slide Sorter uses the traditional "light table" metaphor, providing on-screen thumbnail sketches of each slide. To reorder a presentation you merely drag images to new locations; frames can be moved and copied between different presentations as well. Those who prefer speed over this visual approach can use the Title Sorter instead.

Working with color is a pleasure thanks to interactive on-screen color palettes and thumbnail representations showing gradient background fill. *PowerPoint* includes a Color Scheme feature tailored to non-artists; you choose a background color which summons a series of designer-selected complementary colors that you can assign to foreground and accent elements. Imported objects can be interactively remapped to the color scheme.

You create Text with the *Word for Windows*-like editor or the Labeler tool, which permanently attaches text labels to a graphic object. The editor comes with a set of Bitstream fonts, and layout guides and grids make aligning text easy.

PowerPoint's graphing module is a noble effort but falls short of ideal. The good news: your data and chart can appear simultaneously on-screen, there are a variety of data import filters, and graphing noncontiguous data is no problem. Each of the six basic chart types has a robust set of options. Also, the program links a chart and its data, so when you give your chart to someone it retains all the supporting information.



This screen was captured in VGA mode, showing dithered colors, but a true color display is possible with boards like the Video-7 VRAM.

The bad news: the graph module is a separate executable file and the tools for color, line thickness, and other attributes are more limited than in the main program. A graph created in the chart module and brought into the presentation can be resized, but not modified.

The drawing tools (lines, ovals, and rectangles) are adequate but not exceptional. However, drawn objects can have interesting style attributes such as frames, drop shadows, and opacity. The clip-art collection, supplied by Genigraphics, is organized as a series of *PowerPoint* presentations, which makes finding the picture you want somewhat cumbersome. Clip art can be pasted into the presentation, recolored, cropped, sized, and labeled with text, but it cannot be broken apart into elements and modified with drawing tools—a serious limitation. Since the package lacks a skewing facility for both text and graphics, presentations can look homogeneous. You can import almost all of the major graphics file formats, but the package supports only the black-and-white TIFF 4.0 specification.

The lack of a text outliner will be considered a serious omission by outline-driven presenters. In contrast, the soon-to-debut PC version of Aldus's Macintosh-based *Persuasion* uses an outliner as its backbone.

Genigraphics provides slide-imaging support; a Genigraphics driver and communications module come with the package. On-screen presentations can be advanced manually or automatically. The slide show does not include transitional effects, but it does offer a few keyboard commands for navigating. There is no runtime version of the slide show.

PowerPoint is full of intelligent commands and ease-of-use features. While there's room for improvement, I suspect that *Harvard Graphics* and *Lotus Freelance* users won't go home again once they've taken *PowerPoint* for a trial run. ■

FACT FILE

Microsoft PowerPoint
Microsoft Corp., One Microsoft Way, Redmond, WA 98052; (800) 426-9400, (206) 882-8080.
List Price: $495.
Requires: 1MB RAM (2MB recommended), *Microsoft Windows* 3.0., 16MB available on your hard disk, EGA minimum (VGA display with a 256 color *Windows* 3.0 driver recommended).
In Short: PC presentation makers have never had it so easy. *PowerPoint* makes the most of the new *Windows* environment as it integrates word processing, charting, drawing, and image import into a cohesive package.

CIRCLE 436 ON READER SERVICE CARD

Two Low-Cost Boards Offer Graphics Workstation Power

HANDS ON
by Salvatore P. Ricciardi

Both the Hercules Graphics Station and Desktop Computing's AGA 1024 use TI's TMS34010 graphics processor; but the most obvious difference is their approach to supporting IBM's VGA standard. The Graphics Station is designed as a single-slot solution, combining onboard VGA with a high-performance graphics processor. The AGA 1024 supports VGA only through a pass-through cable to an existing VGA board. If you can't afford two slots, don't consider the AGA 1024.

Both boards, powered by TI's processor, are capable of driving a compatible display at up to 1024-by-768 noninterlaced resolution with 256 simultaneous colors. The Graphics Station uses the 60-MHz TMS34010 along with Intel's 8-bit VGA controller chipset. The AGA 1024 uses the slower 40-MHz TMS34010.

The Graphics Station supports a special high-definition color mode that exploits the board's 24-bit color capabilities to display photo-realistic images at 512 by 480 resolution. The demo produced beautiful images, but requires custom software such as Time Arts's *LUMENA/Hercules*. Both boards support various other resolutions including 800 by 600 and 640 by 480.

Both have software drivers for *AutoCAD* and *Microsoft Windows*. But the Graphics Station has no driver for *Microsoft Windows/386*. Neither product had *Windows* 3.0 drivers available at the time of this review, nor supports OS/2 Presentation Manager. The AGA 1024 also has DGIS (Direct Graphics Interface Standard) drivers for *GEM* and *Ventura Publisher* as well as an 8514/A adapter-interface driver.

In its standard configuration, the Graphics Station comes with one megabyte of video RAM, some of which can also be used as program memory by the TMS34010. The AGA 1024 comes standard with one megabyte of video RAM and 256K DRAM (dynamic memory) for use as program memory. Both boards can automatically adapt to either 8-bit or 16-bit bus connections.

During testing we were unable to get a Video Seven 1024i board to operate correctly in VGA pass-through mode with the AGA 1024. Desktop Computing confirmed the problem but was unable to provide a solution. In benchmarking the Graphics Station we discovered a possessive bug in Hercules TIGA *Windows* driver that trashed a memory location and put the display into an erroneous mode. (Hercules and TI were working on a free upgraded driver, which should be available now).

The Graphics Station performed well in the *Windows* tests, but didn't do as well during *AutoCAD* testing due to a function that uses local memory instead of EMS (Hercules is working on a driver that uses EMS). The AGA 1024's *Windows* results were unflattering. In order to boost the sluggish performance of Graphics Station's Intel 8-bit VGA controller chip, consider using a product like Quarterdeck's *QEMM-386* to remap the VGA BIOS into fast memory. ■

List Price: Hercules Graphics Station Card, $1,024. Hercules Computer Technology Inc., 921 Parker St., Berkeley, CA 94710; (800) 532-0600, ext. 188. **Requires:** AT or compatible with VGA or analog multiscanning monitor.

CIRCLE 668 ON READER SERVICE CARD

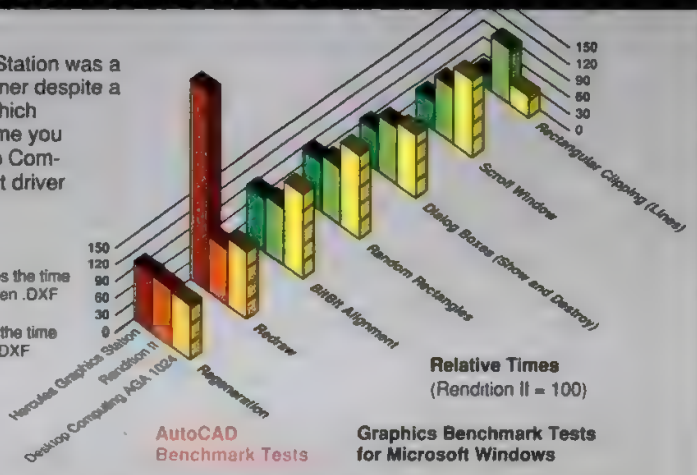
List Price: Desktop Computing AGA 1024, $1,140. Desktop Computing Inc., 2635 N. First St., #203, San Jose, CA 95134; (408) 943-9409. **Requires:** XT, AT, or compatible with VGA or analog multiscanning monitor.

CIRCLE 664 ON READER SERVICE CARD

BENCHMARK TESTS: AGA 1024 AND HERCULES GRAPHICS STATION

PC LABS

The Hercules Graphics Station was a speedy *Windows* performer despite a bug in its TIGA driver (which should be fixed by the time you read this), while Desktop Computing's DGIS display-list driver proved superior in the *AutoCAD* test.



The **Regeneration** test measures the time it takes to regenerate an on-screen .DXF file using the Regen command

The **Redraw** test measures the time it takes to redraw an on-screen DXF file using *AutoCAD's* Redraw command

Both tests are run once for each of three files. The first contains a number of bubble-like entities; the second and third are AIRPLANE DXF and SITE-3D.DXF, both supplied with *AutoCAD* Release 10. Timing begins when the command is invoked and ends when the image has completely reappeared. The reported results are the sum of the three individual times for each test

The **BitBlt Alignment** test uses the *Windows* function BitBlt (bit-block transfer) to move a square block of pixels rapidly from one location to another. We are reporting the results for BitBlts configured as 256-by-256 pixels, using the Source Not Aligned and Destination Not Aligned options for all these tests (a worst-case scenario). In this case, alignment means that the bits describing each row of the bitmap begin on an 8-bit boundary—the start of a byte

The **Random Rectangles** test draws randomly sized rectangles in random colors

The **Dialog Boxes (Show and Destroy)** test generates and erases a *Windows* dialog box 20 times

The **Scroll Window** test scrolls aligned and unaligned text vertically through a rectangular window.

The **Rectangular Clipping (Lines)** test for *Windows* creates four separate, equal, rectangular windows on-screen with space in between them. A full-screen image composed of solid lines is then clipped to the windows

All tests were performed on a Compaq Deskpro 386/25 with an NEC MultiSync 5D 1,024-by-768 monitor running in 1,024-by-768 noninterlaced mode. The *Microsoft Windows* tests were performed using *Microsoft Windows/286* and the PC Labs *Windows* benchmark test, Version 1.1. Each test was performed using an iteration counter of 5. The reported results are the average of the 5 iterations. The Rendition II, from Renaissance GRX, is our benchmark standard

Performance Times (*AutoCAD* tests in seconds)	AutoCAD Benchmark Tests		Graphics Benchmark Tests for Microsoft Windows				
(Graphics tests in milliseconds)	Regeneration	Redraw	BitBlt Alignment	Random Rectangles	Dialog Boxes (Show and Destroy)	Scroll Window	Rectangular Clipping (Lines)
Hercules Graphics Station	18.97	5.60	22.13	7.77	200.14	34.61	[illegible]
Rendition II	18.34	1.58	23.35	8.94	304.18	67.28	1.50
Desktop Computing AGA 1024	17.42	1.90	34.77	13.00	335.04	92.90	0.57

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"3X Link16 is an extremely cost effective, high speed zero-Slot Lan"

Doug Allinger/**LAN Technology**

As your stomach takes a long time to digest heavy meals, so do small workgroups with heavy LANs. Expensive and heavy LANs sold nowadays are hard to install, to use and maintain. They require qualified people and are not suitable for small workgroups.

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CIRCLE 234 ON READER SERVICE CARD

SoftType Generates PCL and PostScript Fonts Inside Windows

HANDS ON
by Edward Mendelson

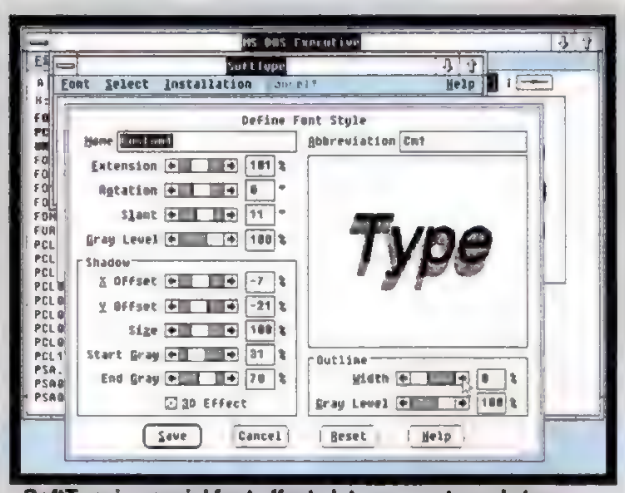
When your appetite for fonts becomes ravenous, it may seem nothing can satisfy it. But *SoftType*'s 63 typeface outlines, with potentially infinite variations of shape and shading for each outline, can come close.

ZSoft's $199 font generator is a *Windows*-based program that creates printer fonts for LaserJet- or PostScript-compatible printers, and screen fonts for *Microsoft Windows* or *Ventura Publisher*. Its 63 typeface outlines—all made by the German typehouse URW—come in a variety of styles. You can also use *SoftType* to create printer fonts from the proprietary outline format used in ZSoft's *Publisher's Paintbrush* and other programs, or from outlines created in ZSoft's *Publisher's Typefoundry*. Other common formats, like Bitstream's or Agfa Compugraphics' *Intellifont*, aren't supported.

Using *SoftType* is easy. You select PCL, PostScript, or *Windows* GDI as the desired output device for your fonts. (*Windows* GDI fonts can be used by Epson-compatible 9-pin printers). You then simply select one or more typeface outlines. Font generation is slow under *Windows 2.x* but acceptably fast under *Windows* 3.0; speed improves with a math coprocessor. You can run other *Windows* applications while *SoftType* generates fonts in the background.

Program options let you automatically create matching *Windows* screen fonts when you create printer fonts or at any custom resolution needed by a high-resolution monitor. You can also select among a variety of predefined character sets. A determined and expert user should be able to create custom character sets by modifying the ASCII files that define the supplied character sets, but the manual gives no help, and the job will require hours of trial and error.

SoftType is especially flexible in the modifications it lets you make to basic type designs. You can vary the original design by stretching, slanting, rotating, adding shadows, or printing in different levels of gray. In unskilled hands, the results can butcher the original design, but the dramatic effect of rotated or shadowed type at large sizes makes it worth the risk.



SoftType's special font effects let you create and store custom variations on standard type styles.

A sampling of Soft Type's 63 display and text fonts. The samples were printed using the HP LaserJet III.

SoftType's URW outlines give you plenty of variety but some of the designs tend to be oversimplified.

LaserJet-compatible fonts generated by *SoftType* are finely detailed bitmaps that work with any PCL printer that accepts soft fonts. The program can apply compression techniques compatible with the LaserJet IIP and III but can't create scalable font outlines used by the LaserJet III. When you create PostScript-compatible typefaces, the results should be usable with any PostScript printer, but because the fonts aren't hinted like Adobe's Type 1 fonts, the results will look crude on low-resolution printers.

SoftType does all the work of installing its printer and screen fonts in *Windows*. As with other font generating programs, *Ventura* users will need to take a few extra steps. You can use *SoftType*'s fonts with other software, but it won't be easy. The font files use arbitrary letters and numbers for filenames, so it's hard to keep track of what you've got when you're outside the *Windows* environment. Third-party font installers like SoftCraft's *Font Solution Pack* and HP's *Type Director* can ease the task of installation in non-*Windows* applications. And SoftCraft's package lets you modify fonts in ways similar to *SoftType*'s, but without the easy *Windows* interface.

The weakest part of *SoftType* is its URW typeface outlines. These seem optimized for use at 300 dots per inch, with the result that many typefaces lose much of their unique individual character. Many of the subtle elements in faces like Palatino, Frutiger, and Univers tend to disappear in the simplified versions that *SoftType* calls Palacio, Roissy, and Galaxy. Elegant text faces like Bodoni, Garamond, and Baskerville look coarse in the URW versions, and the "Roman" font is a travesty of Times Roman. Bitstream's *Fontware* and SoftCraft's Bitstream-licensed font-generating programs produce far superior results, but at a much higher price.

Display faces like Blippo, Cooper, and Stencil fare much better than text faces. For these, and for inexpensive access to dozens of text faces, nothing approaches the ease and economy of *SoftType*. ■

FACT FILE

SoftType
ZSoft Corp., 450 Franklin Rd., #100, Marietta, GA 30067; (404) 428-0008.
List Price: $199.
Requires: 640K RAM, hard disk, *Windows* 2.1 or later.
In Short: An enormously flexible and economical font generator, with 63 moderately well-designed typeface outlines.

CIRCLE 430 ON READER SERVICE CARD

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QA-75 LCD Panel

Actual Display

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CIRCLE 395 ON READER SERVICE CARD

Scrimage Generates Screen And Menuing Code for Several dBASE Dialects

HANDS ON
by Salvatore P. Ricciardi

Designing and coding screen displays, input forms, and menus is a tedious task, all too familiar to *dBASE* programmers. *Scrimage*, from Synergy Corp., is a screen design tool that cuts this task to size. The program lets you design and modify screen and menu items, and then it generates the requisite *dBASE* code.

Screens and menus are designed interactively using *Scrimage*'s drawing support, which lets you use any ASCII character to create the display. The program also lets you automatically join line intersections and paint any characters or lines in the color of your choice.

The screen editor includes block operations such as copy and move that make it easy to take your design through several prototypes. For example, you can wrap and center text within boxes or drag objects to reposition them on the screen.

Scrimage's box/window object metaphor maps well to *FoxPro* and *dBASE IV*. You can create boxes in an object stack, and manipulate them individually. Cursor movement and text entry are restricted to the selected box.

Fields can be created on the fly, or included by choosing an existing .DBF field. A defined field can have a number of characteristics such as a default value, a valid clause, picture templates, and functions.

Scrimage supports several of the more popular *dBASE* dialects including *FoxPro, dBASE IV* and *Clipper*. For this reason alone, it is very helpful to anyone who needs to port screen code between dialects. It also supports several alternative methods of coding menus for the various dialects. And while Synergy's *Scrimage* uses its own proprietary format for saving screens, it can also support a number of standard file formats, including *dBASE IV/FoxPro*, .WIN, *Clipper* .MEM, and ASCII files. Changing styles and regenerating code is quick and painless.

Doing simple things in *Scrimage* proved easy, but taking advantage of some of its more powerful features such as generating multilevel menus requires experimentation. ■

List Price: *Scrimage*, Version 2.0, $149. **Requires:** 384K RAM, DOS 2.0 or later. Synergy Corp., 6289 W. Sunrise Blvd., #257, Ft. Lauderdale, FL 33313; (305) 792-1866.

CIRCLE 435 ON READER SERVICE CARD

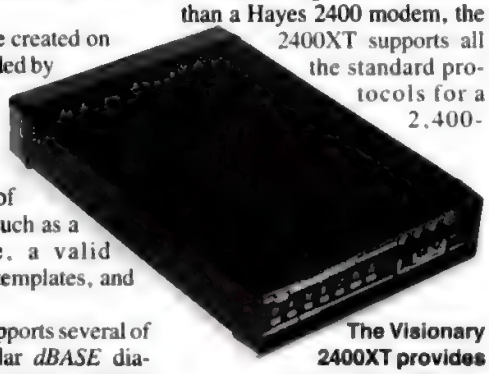
Scrimage is a screen design tool that generates code for a number of different *dBASE* code dialects.

A Modem with a Mind For Communications

HANDS ON
by Robert W. Kane

With the trend these days toward more intelligent peripherals, modems have a lot of catching up to do. Leading the race is Visionary Electronics of San Francisco, California. Their $495 2400XT Buffered Modem provides all the functionality of a Hayes 2400 plus the ability to perform as a standalone communications workstation.

Measuring an inch shorter than a Hayes 2400 modem, the 2400XT supports all the standard protocols for a 2,400-bits-per-second modem including V.22, V.22bis, Bell 212A and 103 series. A DB25 connector and RJ11 jack facilitate hook-up to any PC and standard telephone line. Compatible with the AT command set for a Hayes 2400, most commercial software will work without problems on the 2400XT.



The Visionary 2400XT provides the functionality of a standard modem as well as standalone communications workstation capabilities.

The 2400XT shines in its programmability. With a standard buffer size of 8K, upgradable to 1MB, the 2400XT has the ability to upload and download files without computer supervision. Extensions to the standard AT command set allow files within the modem's memory to be displayed, sent, received, and deleted. Additional commands permit conditional command execution based upon an event, such as receiving a specified string of text or a date and time trigger. Binary file transfer is supported with the built-in Xmodem protocol.

With the addition of a $30 Y cable, the 2400XT can support a standard parallel printer. Once programmed, the modem and printer ensemble can function as a standalone remote message terminal, printing out incoming messages automatically. Three different programs can be stored and recalled with the user-programmable buttons on the front of the unit, allowing the 2400XT to function as a standalone entity.

The only flaws in the 2400XT are its lack of both a power switch and a second RJ11 jack to hook up a standard telephone. Without the switch, the 2400XT must remain on all the time in order to keep the real-time clock functioning (although the contents of the memory are maintained with a nickel cadmium battery). There's no room in this crowded unit to add a second RJ11 jack.

These two points aside, The Visionary 2400XT breaks new ground in advancing intelligent modems. Although priced at a premium, its standalone features can save you time and money. ■

List Price: The Visionary 2400XT, with 8K buffer, $495; with 256K buffer, $595; with 1MB buffer, $695. Quantity discounts available. Visionary Electronics Inc., 141 Parker Ave., San Francisco, CA 94118; (415) 751-8811.

CIRCLE 434 ON READER SERVICE CARD

PC SALOON

NICE TO KNOW WHEN

GbsSlipBack-001B

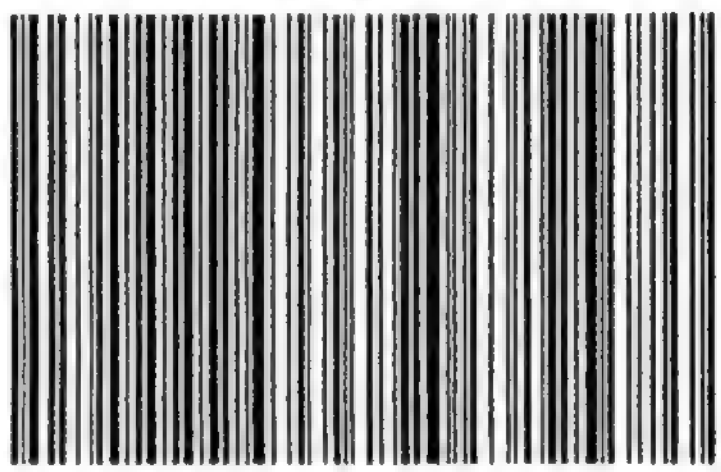
Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

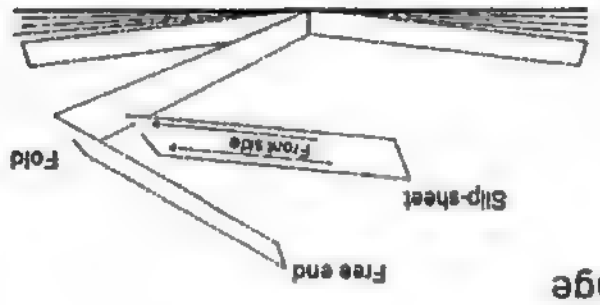
Folded edge of the page



GbsSlipSheet-001

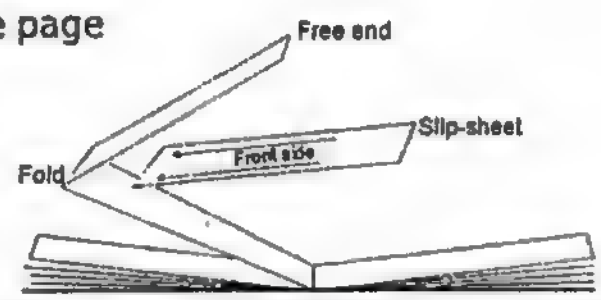
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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First Looks

VP to the Max Gives Ventura Users a Lexicon

HANDS ON
by Alfred Poor

You can't be too thin, too rich, or spell-checked too often. *Ventura Publisher* users typically import text that's been carefully checked by external word processors, but typos can creep into a document during final desktop publishing preparations. *VP to the Max*, a *Ventura* add-on from Aristocad Inc., offers a safety net with a spell-checker, thesaurus, and useful formatting aids. This $199 program runs on top of *Ventura*, adding new selections to Desk command.

The 116,000-word spell-checker, based on Proximity's popular Linguabase, searches for unrecognized words, and provides a point-and-shoot list of replacement suggestions. You can add new words to the dictionary (limited only by storage space) but you cannot create multiple dictionaries. When you run spellcheck Ventura is closed. All files must be saved in ASCII format before being checked, a minor irritant but a painless operation using the *Ventura* File Type/Rename option under the Edit menu. You can check a single text file or an entire chapter but, since the program cannot directly read the *Ventura* screen, you need to enter each word into a dialog box manually.

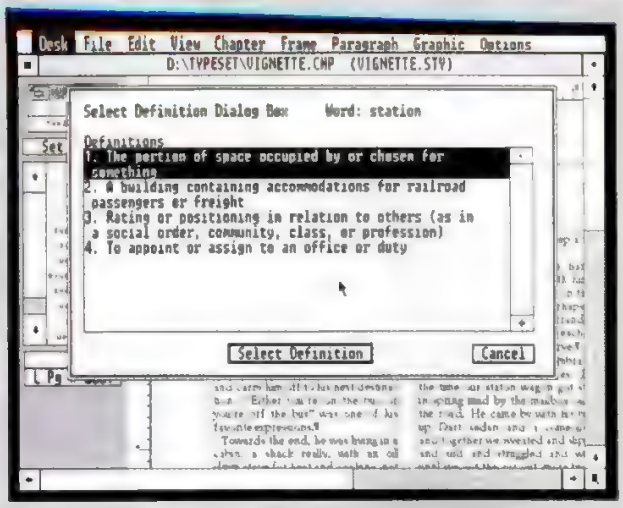
The thesaurus, also from Proximity, contains over 470,000 synonyms, antonyms, and definitions. However, the supply of antonyms seems a bit thin. To use the thesaurus, you manually type the word into the dialog box. Unlike some other electronic thesauri, this one offers different definitions for a given word which makes it easy to hone in on a particular meaning. Some words that have multiple meanings get limited coverage, especially words used as both verbs and nouns.

The program also includes welcome formatting aids. The search and replace feature speeds up editing and formatting changes since it can search and replace *Ventura* paragraph tags. There's also a feature that lists all the tags for the current style, and lists basic information from the tag definition, such as the typestyle, size, alignment, and typographic effects.

The program is easily installed; the documentation is adequate. You should be able to put it to work the moment you see the new menu choices. ■

List Price: *VP to the Max*, $199.
Requires: Xerox *Ventura Publisher* 2.0 or above (with or without Professional Extension); at least 1.2MB free disk space on same drive as *Ventura*; requires less than 6K RAM in addition to *Ventura*. Aristocad Inc., 1650 Centre Point Dr., Milpitas, CA 95035; (800) 338-2629 outside CA, (800) 426-8288 inside CA.

CIRCLE 431 ON READER SERVICE CARD



VP to the Max's thesaurus is organized by definition.

Bridge 2.0's Batch Language Improves with Win 3.0

HANDS ON
by Barry Simon

Microsoft Windows 3.0 can run multiple programs and interapplication communications but it can't fully automate the environment. The most powerful way to customize *Windows* is with Bridge 2.0, a batch language from Softbridge Microsystems Corp.

Bridge's language elements resemble both DOS and BASIC. Elements include if-then-else, GOSUB, local variables, and arrays. The language is comparable to enhanced batch languages for DOS like Seaware's *EBL* and Microcom's *Beyond Bat*.

Developers can use Bridge to create custom menus for integrated environments. Creating on-screen dialog boxes is easy with the Bridge Editor. An interactive dialog box editor presents components as graphical elements on a menu. You create a dialog box by choosing elements and placing them with a mouse. Choices include check boxes, radio buttons, drop-down combo boxes, and list-choice boxes. The requisite code is automatically created in your Bridge batch file.

Keystrokes or hotkeys can launch applications; windows can be resized, moved, hidden, or closed. On-screen messages can use any color or font your system supports. Simple commands let you produce branching or cascading menus.

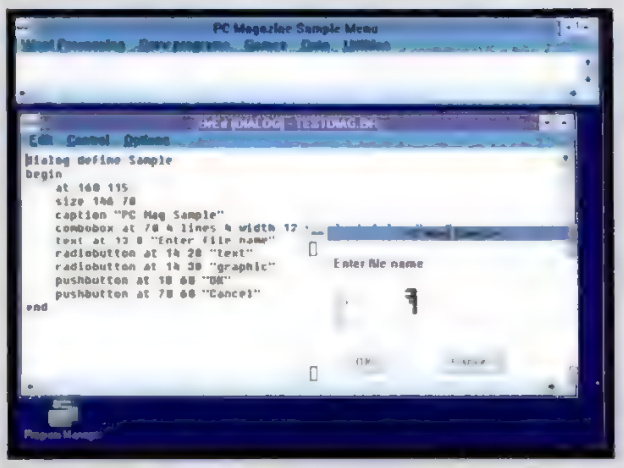
Softbridge developed the Recorder program provided with *Windows* 3.0. Ironically, that program records macros you can't edit, while Bridge lets you edit macros, but not record.

Bridge transfers data between *Windows* apps via DDE. It offers two TSRs occupying about 50K that give you some data-sharing capabilities in DOS sessions, especially if you are running *Windows* in 386 Enhanced Mode. It also operates over any NetBIOS-compatible LAN and can be customized to take certain actions when triggered by a remote terminal.

Bridge is a remarkable package, especially with *Windows* 3.0's improved memory management. Unfortunately, its current $695 price tag is daunting. ■

List Price: Bridge 2.0, $695.
Requires: Windows 2.03 or later. The Softbridge Microsystems Corp., 125 Cambridge Park Dr., Cambridge, MA 02140; (617) 576-2257.

CIRCLE 433 ON READER SERVICE CARD



The BrEd editor lets you build up dialog boxes graphically, and save them in Bridge or *Windows*' SDK format.

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SCO Xenix Complete System 386	1079.00
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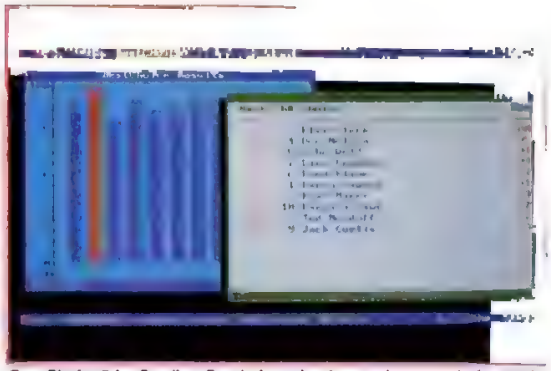

BestChoice3 by Sterling Castle is a simple yet elegant solution to the problem of decision making. Whatever business decisions need to be made, BestChoice tackles the problem in a logical manner simulating the way people think. You enter three types of information to build any decision model and the most complex decisions are broken down into a natural and more manageable format. It is a logical process, simple to learn and easy to use. BestChoice3 $62.00.

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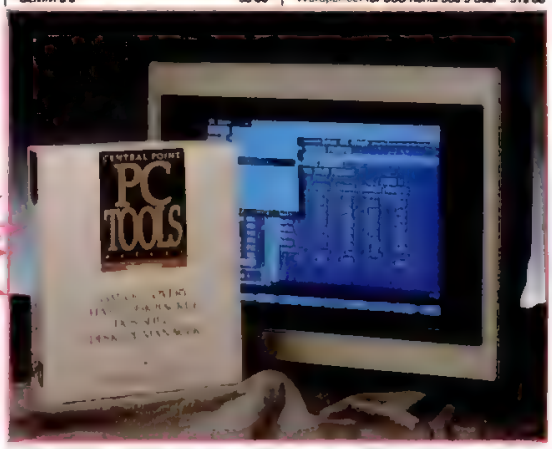

PC Tools Vers. 6.0 is the last utility anyone will need. It contains the most powerful collection of DOS utilities including a comprehensive DOS Shell, Data Recovery including undelete, unformat and diskfix, A Hard Disk Backup utility with tape drive support and other features. It also contains a desktop manager with a full database, telecommunications for E-Mail, Notepads, Schedulers and a Macro Editor as well as a memory caching system, file compression and PC Secure to password protect sensitive data. With modes for beginner, intermediate and advanced users it is the ultimate utility for all PC users. PC Tools 6.0 $80.00.

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by Matthew J. Ross

New & Improved

News of Announced Products and Upgrades

Adobe PostScript Cartridge for LaserJet II

NEW

Adobe Systems has introduced The PostScript Cartridge for the Hewlett-Packard LaserJet II, containing Adobe's industry-standard PostScript interpreter and 35 standard outline typeface programs. Other features include screen fonts for *Microsoft Windows* and *Ventura Publisher*, support for Adobe's Type Master rasterizing capabilities, the ability to switch between PCL and PostScript from either the printer control panel or the PC, and manufacturer-claimed performance increases of 1.5 to 3 times that of other LaserJet II-compatible PostScript cartridges. With The PostScript Cartridge, LaserJet II users gain access to the Adobe Type Library.

List Price: The PostScript Cartridge, $495. **Requires:** 1.5MB of printer memory. Adobe Systems Inc., 1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; (415) 961-4400.

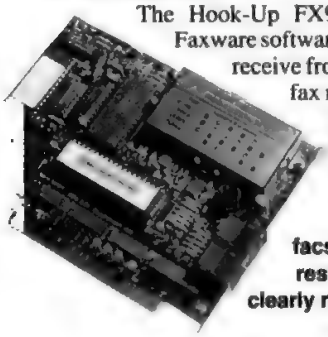
CIRCLE 438 ON READER SERVICE CARD

CPI Ships FaxModem; Brings PostScript to LaserJet III

NEW

Computer Peripherals has introduced two new products for business computing: the Hook-Up FX96/24 combination 9,600-bit-per-second fax board and 2,400-bps internal modem, and the JetPage PostScript emulation cartridge for the LaserJet III.

The Hook-Up FX96/24 with its Faxware software can send to or receive from any Group 3 fax machine. Other features the system comes with include a direct interface to *WordPerfect*, *WordStar*, and *MultiMate;* immediate or scheduled background fax transmission; conversion between fax and .PCX file formats; and automatic switching between fax and data on incoming calls.



The Hook-Up FX96/24's facsimile circuitry resides under the clearly marked jumper combinations.

The JetPage PostScript emulation cartridge ships with 35 equivalent fonts to the standard set of PostScript fonts offered by Adobe, including: Helvetica, Times Roman, Palamino, ITC Bookman, Century Schoolbook, and Courier. JetPage is PCL-compatible and renders a PostScript image in 1.5MB of printer memory, requiring only a 1MB memory upgrade for the LaserJet III. It also ships with a limited five-year warranty.

List Price: Hook-Up FX96/24, $495, JetPage PostScript Emulation Cartridge, $495. Computer Peripherals Inc., 667 Rancho Conejo Blvd., Newbury Park, CA 91320; (800) 854-7600, (805) 499-5751.

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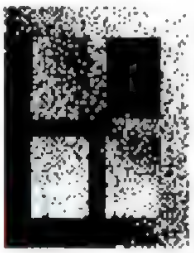

Microsoft Windows 3.0 Applications

Microsoft's carefully planned $10 million roll-out of Version 3.0 has caused a flurry of activity among software developers. Listed by category below are some of the new *Microsoft Windows* 3.0 applications that have begun shipping or will become available throughout July.

The recommended system requirements for *Windows* 3.0 are a 286- or 386-based system with at least 2MB of memory, a graphics adapter and monitor, a hard disk, mouse, and DOS 3.1 or later.

Communications

Access for Windows is a fully graphical 3270 emulation package that supports *Win 3* applications and terminal-to-host connectivity simultaneously. *Access/W* is a combination software/hardware product that includes the EiconCard communications board, and offers full support for APL and the IND$FILE transfer protocol, keystroke macro recording, and programmable on-screen keyboard softkeys. *Access/W* retails for $495 as a standalone application or $4,950 in its network version. The EiconCard must be purchased separately for $995, and an SNA Gateway is available for $1,800. Contact Eicon Technology Corp., Montreal, Canada; (514) 631-2592.

Microcom has introduced a communications package featuring 3270 emulation as

CONTINUES ON PAGE 54

HOT PROSPECT

Wingz from **Informix Software** is a graphical spreadsheet that lets users work with text, data, and graphs in a single application. *Wingz* incorporates desktop publishing, advanced charting, and 3-D graphing functions. Originally released for the Macintosh, *Wingz* also features Informix's HyperScript application development language. According to the manufacturer, HyperScript facilitates creating personal information systems and customized applications. The *Wingz*-DataLink provides a graphical interface for local or remote SQL database queries. *Wingz* is one of the first packages to take full advantage of the graphical and data-linking features in *Windows* 3.0.

List Price: *Wingz*, $499. **Requires:** *Microsoft Windows* 3.0. Informix Software Inc., 4100 Bohannon Dr., Menlo Park, CA 94025; (415) 926-6300.

CIRCLE 437 ON READER SERVICE CARD

ReadRight Supports Hand Scanners

NEW

OCR Systems has begun shipping *ReadRight Personal*, an omnifont page recognition package created specifically for use with hand-held scanners. *ReadRight Personal* features the *ReadRight 2.01* omnifont recognition engine with a new interface. Documents may be scanned either vertically or horizontally, with intelligent merging to reconstruct the full page. TIFF and .PCX file formats are supported, and direct scanner support is provided for the Logitech ScanMan and ScanMan Plus, The Complete PC Half Page Scanner/400, the DFI Handy Scanner 3000 Plus, and the Marstek Mars 105 and Mars 128 Hand Scanners. OCR Systems has also announced *ReadRight for*

CONTINUES ON PAGE 54

New&Improved

READRIGHT

CONTINUED FROM PAGE 53

Windows, scheduled for release later this summer.
List Price: *ReadRight Personal*, $249.
Requires: 640K RAM, hard disk, DOS 3.0.
OCR Systems Inc., 1800 Byberry Rd., #1405, Huntingdon Valley, PA 19006; (215) 938-7460.

CIRCLE 440 ON READER SERVICE CARD

WINDOWS 3.0

CONTINUED FROM PAGE 53

well. *Relay Gold For Windows* supports up to 15 concurrent sessions and supports several file transfer protocols, including: Xmodem Checksum, CRC, 1K, Ymodem Batch, Kermit, and IND$FILE. *Relay Gold For Windows* costs $299 from Microcom Software Division, Norwood, Mass.; (617) 551-1999.

Access for Windows

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Relay Gold For Windows

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Development Tools

ObjectScript is a new object-oriented toolkit for the *Windows* environment, designed to create graphical interfaces and to synchronize windowing. *ObjectScript* features a QuickBASIC-like programming language and retails for $150. A C language version of the program is available for $500.

ObjectView is a three-component front end and development tool to the SQL Server relational database engine. The program has a graphic editor that contains the functionality of *ObjectScript*, a SQL query system, and a report writer; it retails for $795. Both *ObjectScript* and *ObjectView* are products of MATESYS Corp., Washington, D.C.; (202) 785-0770.

Rochester Software Connection's *ShowCase*, is a *Windows*-based development tool for building graphical applications for AS/400 communications links. *ShowCase* consists of an AS/400-resident server that communicates to the PC via APPC, a PC-resident requester, and a PC-based development platform that supports data exchange with PC applications. The runtime server of *ShowCase* retails for $580 from Rochester Software Connection Inc., Rochester, Minn.; (800) 829-3555, (507) 288-5922. Data entry ($480) and report generating ($380) modules are also available.

Spinnaker Plus for *Windows* 3.0 is an object-oriented programming environment with Macintosh and OS/2 (later this summer) counterparts, allowing developers to create customized, hypermedia information applications that are compatible across PC and Macintosh platforms. *Spinnaker Plus* retails for $495 from Spinnaker Software, Cambridge, Mass.; (617) 494-1200.

ObjectScript

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ObjectView

CIRCLE 444 ON READER SERVICE CARD

ShowCase

CIRCLE 445 ON READER SERVICE CARD

Spinmaker Plus

CIRCLE 446 ON READER SERVICE CARD

OCR/Graphics

Image-In is a new integrated graphics toolkit that combines scan and paint functions, OCR, raster-to-vector line conversion, gray-scale processing, and an image database manager. *Image-In* retails for $795 from Image-In Inc.,

CONTINUES ON PAGE 59

IMPROVED

***DrawPerfect*, Version 1.1**—WordPerfect Corp.'s recently released presentation graphics program has just improved to include a runtime module. Other new functions include: a Group and Ungroup command, align and center features, .EPS file import and export, color PostScript support, better zoom, point manipulation, five new fonts and more. *DrawPerfect* 1.1 retails for $495 with a $15 upgrade available from WordPerfect Corp., Orem, Utah; (801) 225-5000.

Dolch P.A.C. 486-25—Dolch Computer Systems' latest 486-25 features a 10-inch 640-by-480 VGA color display. According to the company, its thin film transistor (TFT) active matrix display offers a contrast ratio of 100:1, with superior color, a larger viewing angle, and faster screen updates than conventional color LCDs. The Dolch P.A.C. 486-25 with the color display sells for $16,990. The color display is also a $3,995 option on the Dolch P.A.C. 386-25C. Dolch Computer Systems, San Jose, Calif.; (408) 435-1881.

***HyperPAD*, Version 2.0**—The newest release of Brightbill-Roberts' character-based, object-oriented environment incorporates 50 new programming commands, better memory management, EMS support, a *NetWare* utility application, context-sensitive help, and a hypertext tutorial. *HyperPAD* 2.0 is available for $149.95 from Brightbill-Roberts, Syracuse, N.Y.; (315) 474-3400. Upgrades are available for $30.

***Instant Recall*, Version 1.2**—Chronologic's personal information manager's new features include: mouse support, support for databases on network drives, time and date stamping, streamlined movement between text screens and other fields, and access to multiple data directories. Version 1.2 resides in 28K of memory. Available from Chronologic Corp., Tucson, Ariz.; (800) 848-4970, (602) 293-3100. *Instant Recall*'s price remains $99.95, with upgrades to Version 1.2 available for $29.95 plus a $5 handling fee.

Lotus Agenda* 2.0, *LotusWorks—To flatten the learning curve for *Agenda* users, Lotus Development Corp. now ships *Agenda* with four Starter Applications. Additional information views have been added, including "Datebook," which can parse text for appointment times. The product also supports PostScript printers and beefed-up macro facilities. *Agenda* retails for $395 with a $99 upgrade available for registered users.

Lotus also acquired *AlphaWorks*, a low-end integrated software package that will be marketed under the name *LotusWorks*. The package retails for $149, with upgrades from *AlphaWorks* 1.0 available for $49 from Lotus Development, Cambridge, Mass.; (617) 577-8500.

***NetWare 386*, Version 3.1**—*NetWare 386*, Version 3.1, has enhanced its file system for more efficient access to both disk and mounted server volumes. Other improvements include multi-

CONTINUES ON PAGE 56

"Inexpensive, easy to install and does what it claims."
Stan Miastkowski
Byte Magazine
March 1990

"Idea of the Year Department: One of the best concepts I've seen this year."
John C. Dvorak
PC Magazine
April 24, 1990

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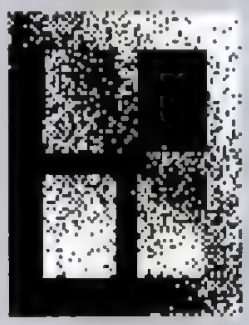
IMPROVED

CONTINUED FROM PAGE 54

protocol support, a new operating system resource manager, enhanced Token-Ring support, EISA support (with memory no longer limited to 16MB by the operating system), and increased Novell-certified third-party support. *NetWare 386*, Version 3.1, lists for $7,995; all registered Version 3.0 users will receive a free upgrade from Novell Corp., Provo, Utah; (801) 379-5900.



Microsoft Windows 3.0 Applications

A host of companies have migrated their applications to the *Windows* 3.0 environment, which offers, in many cases, faster screen updates and more efficient memory handling. If you are interested in finding out about the availability of any *Windows* 3.0 products, Microsoft has a *Windows* hotline through September 15, 1990. The number is (800) 323-3577. These products include:

CAD

Foresight Resources Corp. (Kansas City, Mo.; (816) 891-1040) has added HPGL to ***Drafix Windows CAD* 1.1**. This new version is available, at no charge, to users of Version 1.0.; the retail price remains $695.

***Inertia* 3.1** now has a 3-D mesh generator and shading that allow you to create solid models. The *Inertia* 3.1 program consists of eight modules with prices starting at $995. Upgrades cost $50 from Modern Computer Aided Engineering, West Lafayette, Ind.; (317) 497-1550.

Communications

Among the many updated communications packages is ***Crosstalk for Windows* 1.1**, which sells for $195 from DCA/Crosstalk Communications, Alpharetta, Ga. For information on the free upgrade, contact DCA at (404) 442-4000.

Version 3.0 of Future Soft's ***DynaComm*** asynchronous and 3270 communications packages are now available. Each version of *DynaComm* 3.0 retails for $295. Upgrades will be determined on a case-by-case basis (dependent on the time of purchase) by Future Soft Engineering Inc., Houston, Tex.; (713) 496-9400.

Other communications upgrades include Attachmate Corp.'s 3270 connectivity package, ***EXTRA! for Windows* 1.2**, which retails for $425, with free upgrades available from the Bellevue, WA, company at (800) 426-6283 or (206) 644-4010; and Wall Data Inc.'s ***Rumba* 3.0** 3270 software, which now "hotlinks" *Win 3* applications to IBM 3270 programs. *Rumba* 3.0 costs $595; upgrades are free from Wall Data Inc., Redmond, Wash.; (206) 883-4777.

Databases

dbVista 3.15 Database Management System from Raima Corp. (Bellevue, Wash.; (800) 327-2462, (206) 747-5570), is available featuring dynamic link library (DLL) support. Upgrades are available dependent upon each users' particular support plan.

Other database announcements include a new ***Paradox*** engine (Release 2.0) to ship this summer from Borland International, Scotts Valley, Calif., for $495. For information on purchasing and upgrades, call (800) 331-0877. Also ***SQL Windows* 1.3** is available for $1,295, with free upgrades to all members of the extended support plan, from Gupta Technologies Inc., Menlo Park, Calif.; (415) 321-9500.

Desktop Publishing

***PageMaker* 3.01**, an interim release of Aldus' desktop publishing software, is now available. Version 4.0, which promises substantial text editing features, is scheduled to ship in the fall. *PageMaker* 3.01 is available for a $25 upgrade fee from Aldus Corp., Seattle, Wash.; (206) 628-2320.

CONTINUES ON PAGE 59

"The fastest portable on the planet . . ."

"For fast high-end portable computing, nobody beats the Dolch . . .
. . . this speed demon outran every portable computer
PC Labs has ever tested."
Mary Flynn, PC-Magazine, The Best of 1989

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1990 . . . "The Dolch P.A.C. 386-25C offers just about everything: high-quality construction, a highly readable VGA plasma screen, a superb keyboard, three empty slots for expansion, and the best overall performance of any system tested."

PC MAGAZINE EDITORS' CHOICE March 13, 1990 Dolch P.A.C. 386-25C

1989 . . . "The Dolch P.A.C. 386-25C is the fastest portable ever to fly through PC Labs' benchmark tests. The Dolch P.A.C. is a well designed, well constructed portable powerhouse . . . simply outclasses its competitors."

PC MAGAZINE EDITORS' CHOICE December 12, 1989 Dolch P.A.C. 386-25C

1988 . . . "Of the dozen machines tested the Dolch P.A.C. 386-20C comes closest to the portable desktop ideal. While the Dolch and Compaq Portables are the same shape, size and weight, Dolch aces Compaq, three free internal slots to none."

PC MAGAZINE EDITORS' CHOICE October 11, 1988 Dolch P.A.C. 386-20C

1988 . . . "The Dolch P.A.C. 386-20C was the fastest machine tested, and offers the best display. It is a solid performer that outpoints Compaq on our score card."

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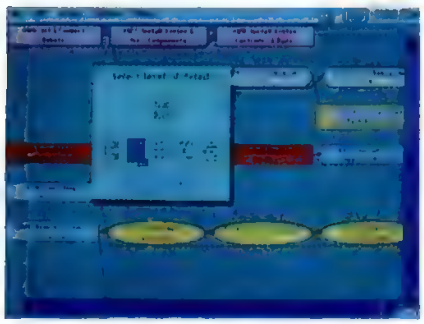
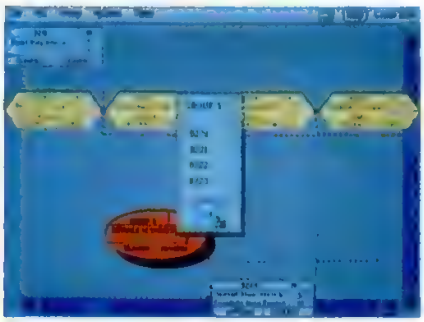
CIRCLE 212 ON READER SERVICE CARD

Primavera introduces some important new project management terminology.

Click-Click—use double clicks to add activities, define relationships, and modify activity data.



Zoom — five levels of detail for your network, from bird's-eye to close-up.



Explode—The Collapse command compresses several activities into one; Explode redisplays activities in their original positions.

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WINDOWS 3.0

CONTINUED FROM PAGE 54

Minneapolis, Minn.; (612) 888-3633.

Computer Presentations (Cincinnati, Ohio; (513) 281-3222) has released a file compression and conversion package for *Windows*. *ImagePrep* 3.0 can convert TGA, TIF, GIF, EPS, PCX, and BMP images and compress them to 1/20th of their original size. *ImagePrep* has a suggested retail price of $295.

Calera has two new OCR packages featuring deferred processing, built-in dictionaries, fax support, and dot matrix scanning, with the professional system featuring a pop-up image verifier. *WordScan* and *WordScan Plus* retail for $595 and $995 respectively, from Calera Recognition Systems, Santa Clara, Calif.; (800) 544-7051 (ext. 8082), (408) 986-8006. ■

Image-In
CIRCLE 447 ON READER SERVICE CARD

ImagePrep
CIRCLE 448 ON READER SERVICE CARD

WordScan
CIRCLE 449 ON READER SERVICE CARD

WordScan Plus
CIRCLE 450 ON READER SERVICE CARD

IMPROVED

CONTINUED FROM PAGE 56

Development Tools

One of the busiest areas for *Microsoft Windows* 3.0 applications is in applications management and development tools. Enhanced products within this category include ***Actor* 3.0** from the Whitewater Group, (Evanston, IL; (708) 328-3800) retailing for $695 with a $75 upgrade; and ***CASE:W*, Version 3.0**, which costs $795 (upgrades are $200) from Caseworks Inc., (Atlanta, Ga.; (800) 635-1577, (404) 399-6236).

Additional development tools recently enhanced include: ***I/F Builder 2.0*** for managing mainframe applications locally via SNA 3270 data streams under *Windows* 3.0. The program retails for $17,500 with free upgrades from Viewpoint Systems, (San Mateo, Calif.; (415) 578-1591); and ***InTouch*, Version 3.0**, the operator interface program from Wonderware Software Development Corp., (Irvine, Calif.; (714) 727-3200), whose development environment software begins at $6,995. ***Nexpert Object* 2.0** by Neuron Data (Palo Alto, Calif.; (415) 321-4488)—which can be used as a DLL (dynamic link library) to enhance the performance of other *Windows* applications—retails for $5,000 with a free upgrade for any users with the support and maintenance coverage.

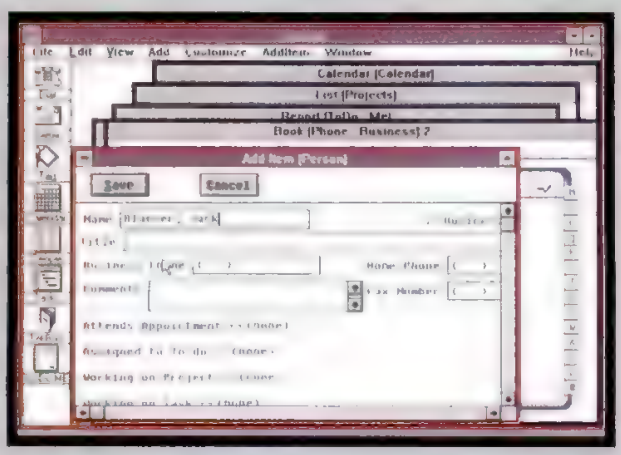
Graphics

Version 3.0 of ***Arts and Letters*** presentation graphics editor is available from Computer Support Corp. (Dallas, Tex.; (214) 661-8960). The new version retails for $695, with upgrades from Version 2.1 available for $50.

AimTech Corp. has released new versions of its ***IconAnimate*, *IconArtist*,** and ***IconAuthor*** multimedia authoring and presentation tools. Further information on each of the packages is available from the Nashua, N.H., company at either (800) 289-2884 or (603) 883-0220.

In other graphics-related announcements, Headland Technology (Fremont, Calif.; (415) 656-7800) is offering a new driver supporting 256 colors under *Win3* with its $397 Video Seven VGA 1024i adapter and its $597 V-RAM VGA card.

Version 3.3 of VideoLogic's Multimedia Interactive Control (M.I.C.) System software for the $2,495 DVA-4000 video adapter is available free of charge for customers. This enables users to capture and manipulate live motion video under *Windows*. Users can contact the Cambridge, Mass., company at (617) 494-0530.



***Current* automatically links related information in its predefined categories such as the calendar, project list, and phone book.**

Personal Information Managers

IBM's ***Current* 1.1** adds several new methods for linking data from other applications, multiple data directories, and cross-linking between related information within *Current*. For information on *Current* 1.1, which retails for $395 and has a free upgrade policy, contact IBM at (800) IBM-7699, ext. 294.

***PackRat* 3.0** has been rewritten to operate under *Windows* 3.0 in both its $395 standalone version ($150 upgrade) or its network version which sells for $695 for three users with additional users costing $150 ($55 per user upgrade) from Polaris Software, Escondido, Calif.; (619) 743-7800.

Program Editor

Bradford Business Systems has improved its full-screen text editor for source code files. ***SpeedEdit*** features over 150 separate editing functions and retails for $295 from Bradford Business Systems Inc., Laguna Hills, Calif., (714) 859-4428. Free upgrades are available for the *Windows*-based version.

Utilities

hDC Computer Corp., (Redmond, Wash.; (206) 885-5550) has upgraded its *Windows Express* 3.0 menuing program and introduced a new utilities package, ***FirstApps***. Both utilities retail for $99.95; *Windows Express* upgrades are available for $19.95 plus shipping costs.

OXKO Corp.'s ***Windows-Tools* 1.1** (Annapolis, Md.; (301) 266-1671) includes screen capture and print tools, and a number of features that will help users with scientific calculations and file administration. Publishing Technologies' ***CBM Desktop Office*, *BatchWorks*,** and ***File Organizer* 3.0** (Austin, Tex.; (512) 346-2835) provide customization, batch scripting and macros, and shell functions respectively. Automated Designs' ***Windows Workstation*, Release 3**, (Atlanta, Ga.; (404) 394-2191) is a collection of LAN utilities running under *Windows* 3.0.

Word Processing

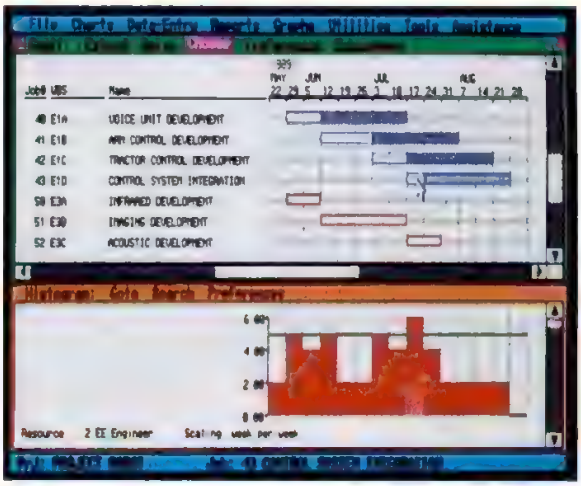
Legacy, NBI Inc.'s upgrade of *Legend 2.0*, adds advanced page layout features, full graphics editing, and improved linking with other applications via DDE. *Legacy* is available for $495 or as a $100 upgrade, by contacting the Boulder, Colo., company at (800) NBI-1111.

"Project Scheduler™ 4:

Finally, an easy-to-use project manager"

PC MAGAZINE, SEPTEMBER 12, 1989

Everyone promises ease of use. Project Scheduler 4 really delivers. Expert after expert agrees, Project Scheduler 4 is the fast track to automated project management. And once you're started, Project Scheduler 4 keeps you going with outstanding power, world-class speed, and industry-leading capacity. Project Scheduler 4 is the clear choice for today, and tomorrow.



Our Gantt Histogram pinpoints resource overloads.

EXPERT TESTIMONY

PC WEEK, MARCH 13, 1989:
"Easy for novices to learn, but packs enough power and functionality for experienced project managers."

DESIGN NEWS, MARCH 27, 1989:
"PS4 is a thorough and complete management system. Its built-in flexibility and abundant features allow for efficient planning of even the most complex projects."

DANIEL YAHDAV, PM SOLUTIONS, JUNE 1989:
"Project Scheduler 4 earns PM Solutions' highest marks in ease of use. It leads its competition in schedule recalculation and resource leveling performance."

PC MAGAZINE, SEPTEMBER 12, 1989:
"Context-sensitive help and three levels of automatic prompting offer enough assistance that you may never open the fine manual that accompanies the program."

"Project Scheduler 4's project management graphs and charts are simply the best around."

"With good scheduling facilities, excellent graphics, and the best interface in its class, the program is well on its way to becoming the premier project manager."

INFO WORLD, SEPTEMBER 25, 1989:
"Project Scheduler 4 is the one program you can't ignore."

"...Project Scheduler 4 provides a superior balance of features and ease of use."

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Project Scheduler 4 is the first PC-based package that integrates high-resolution graphics with all the management tools you need. You understand more because you see more both on screen and in the reports. At last, PERT and Gantt charts make sense. And responsibilities, deadlines, and resource bottlenecks are all spotted at a glance.

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We've made the best product even better with expanded memory support and enhanced reporting and tracking. And you still get the benefits of a full graphic environment without expensive hardware upgrades because Project Scheduler 4 runs under DOS on PC systems from the XT on up.

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edited by
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Read Only

Reviews of the Latest Books for the PC User

New Life for an Old Operating System

■ *Extending DOS*
by Ray Duncan, Charles Petzold, M. Steven Baker, Andrew Schulman, Stephen R. Davis, Ross P. Nelson, Robert Moote
Addison-Wesley, $22.95

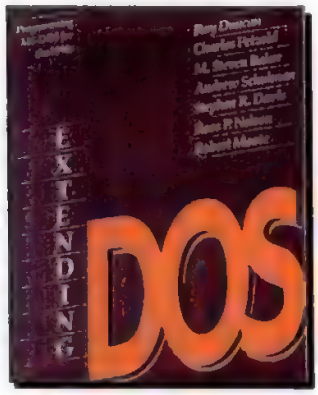
How would you like a clear explanation of using expanded and extended memory to enhance DOS? Or an in-depth look at the relatively new DOS extender technology, which takes advantage of the protected mode abilities of the 286 and 386 chips? What about a solid briefing on DOS-based multitasking environments, namely *Microsoft Windows* and *DESQview?*

These are crucial issues for DOS programmers who constantly find themselves slamming up against the 640K ceiling—a group that will find Addison-Wesley's *Extending DOS* a timely and very well written source of help.

Ray Duncan, a contributing editor of *PC Magazine*, served as general editor of the book, tying together chapters written by himself and six other noted programmer-authors. The quality we've come to expect from him and his strong team of established writers is evident throughout.

Ross P. Nelson sets the stage by explaining the hardware that makes everything possible. Duncan follows with a discussion of expanded and extended memory and their related specifications (EMS and XMS). We've heard all of this before, but by bringing the information together in one place, the book offers a new perspective that makes it all worth hearing again.

Andrew Schulman (a contributing editor of *Dr. Dobb's Journal*) then effortlessly takes



***Extending DOS* offers proof that intelligent books can still be found on bookshelves crammed with junk.**

the reader through the intricacies of 286-based DOS extenders. He is, in my opinion, emerging as one of the best technical writers in the industry, and he really proves it here. Next he teams up with M. Steven Baker (the editor of *Programmer's Journal*) to provide a complete picture of 386-based extenders.

A key factor contributing to the success of DOS extenders is the specification that sets the "standard" for how DOS extenders work. Robert Moote, a cofounder of Phar Lap Software, Inc., and one of the leading voices in the field, provides a very detailed look at VCPI, the Virtual Control Program Interface standard to which DOS extenders adhere. This chapter clears up most of the remaining mysteries about VCPI and is required reading. Duncan also looks at VCPI's soon-to-be successor, DPMI (DOS Protected Mode Interface), and explains its necessity.

For the book's sections on multitasking, Charles Petzold contributes a chapter on the old and new *Windows* environments, while Stephen R. Davis talks about Quarterdeck's *DESQview*. *PC Magazine* readers familiar with Petzold will instantly recognize his tight, concise, and totally illuminating style. Davis's solid chapter on the ideas behind the *DESQview* multitasking model and programming interface reinforce the notion that *DESQview* is a full-fledged programming environment as well as one of the best multitasking systems available for character-based DOS applications.

Moote talks very briefly about multitasking and DOS extender issues, the problems with VCPI, and the way DPMI will cure these problems.

The book makes absorbing reading that works at two levels. It's full of information that many nonprogrammers can easily assimilate (although *Extending DOS* isn't for the novice user who's looking for an intoduction to these topics), and the programmer will find plenty of code examples. The good news is that the information is never treated too lightly, and the code examples never get in the way—they illustrate the points, but the lucid text stands on its own.

The bottom line: *Extending DOS* is a real winner. I have no criticisms; any complaints are too minor to mention. But if you think I may be gushing too much—well, heck, don't take my word for it. Just drop by your nearest bookstore and see for yourself. I guarantee you will add *Extending DOS* to your bookshelf.—**Tony Rizzo**

Addison-Wesley Publishing Company Inc., Rte. 128, Reading, MA 01867; (617) 944-3700. ISBN: 0-201-55053-9.

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Terminology from APL to Zoom Box

■ *Que's Computer User's Dictionary*
edited by Bryan Pfaffenberger
Que Corp., $9.95

As its title conveys, *Que's Computer User's Dictionary* is aimed at computer *users*; the book has a distinct application orientation. For instance, the entry for "column graph" takes up two and a half pages. You won't find "surface mount technology" here, but you will see "em-dash" and "current cell indicator."

In addition, hints and warnings accompany selected terms; for instance, under the "desktop publishing" entry, the book points out some of the limitations of DTP. And, of course, the glossary contains most of the technical jargon an average user will encounter.

The book did have a few errors and eccentricities. For instance, it lists "cel" (an animation-related term) as "cell," and states that EMS swaps 64K chunks rather than four 16K ones. And while there's an entry for "Micro Channel bus," there isn't for "MCA" or "Micro Channel architecture."

Que's Computer User's Dictionary isn't as complete as, say, *The Computer Glossary*, but it's a more focused reference work meant to aid someone who just wants to crank out a small newsletter or create a basic spreadsheet.
—**Lori Grunin** ■

Que Corp., 11711 N. College Ave., Carmel, IN 46032; (800) 428-5531. ISBN: 0-88022-540-8.

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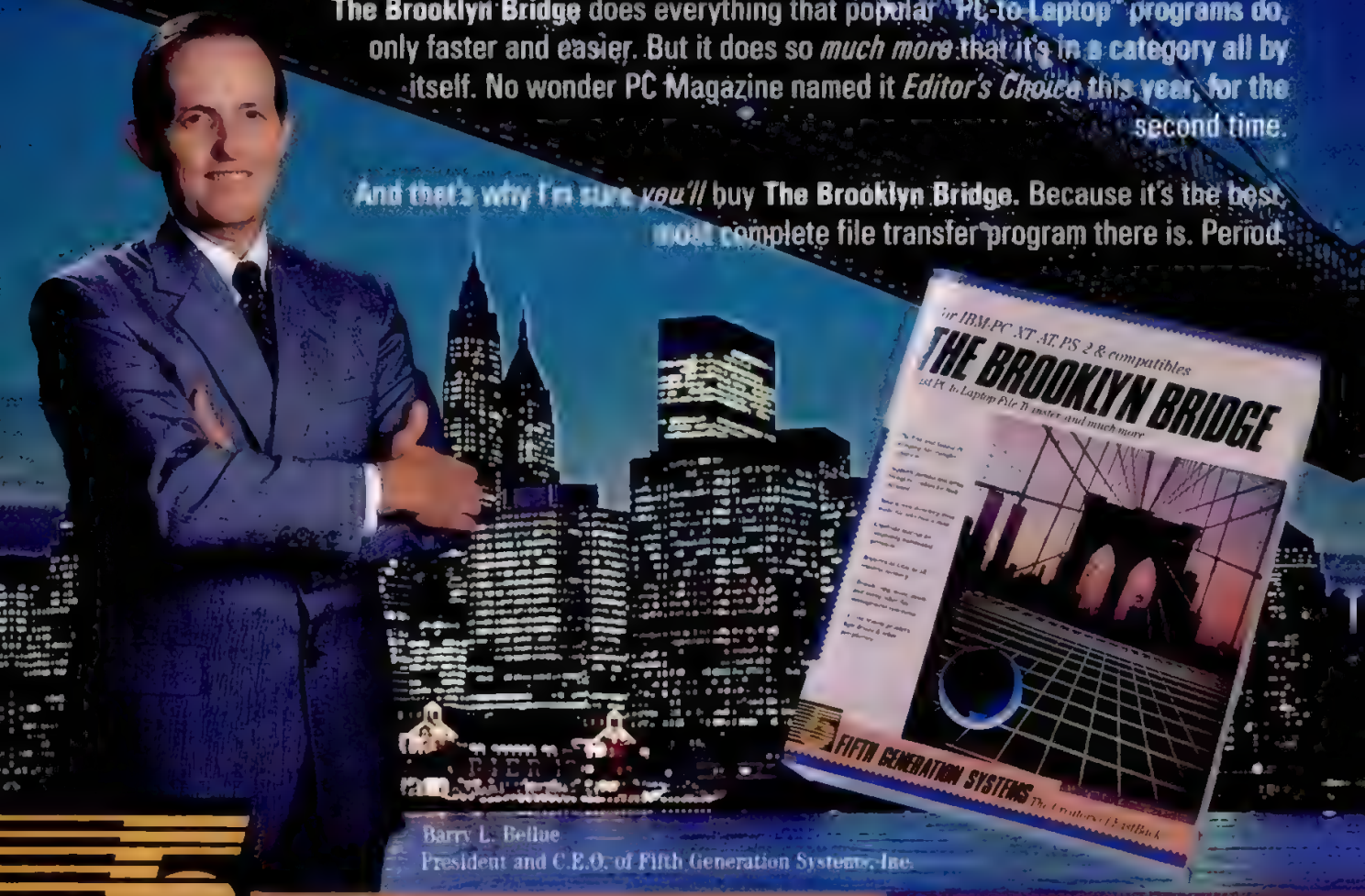

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by Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Intel's Flash Memory Poised to Give Laptops Their Next Great Leap

Last year, Intel unveiled the specs on flash memory: chips that don't lose their contents when the power's turned off. This summer, hardware manufacturers are getting serious about using nonvolatile memory in building lighter PCs and laptops.

Thanks to a few recent developments, it's quite likely that late next year you'll be able to buy a notebook computer that will run for more than 10 hours on a few AA batteries.

A typical system might have a 4MB flash memory disk that would be used like a hard disk. It would have a couple of sockets for loading removable flash memory cards, which would be used to run software or save data. Dynamic system RAM, the screen, and the processor would be the main energy draws. If nothing very heavy or expensive (like a hard disk and rechargeable battery pack) were added, such a system would weigh less than 3 pounds and be sold for less than $2,000.

That kind of machine will satisfy only those who are attracted to today's notebook PCs—but as flash RAM costs come down in the coming years, a flash RAM-based storage system will become as economical as today's hard disks in portable computers.

Right now, flash RAM prices are within 10 percent of the price of dynamic RAM, which costs about $100 a megabyte. (Hard disks small enough for a laptop cost less than $20 a megabyte.)

Laptops are only one use for the technology. As Intel's gone into greater levels of production, a wide range of uses are being found. Airline flight recorders are being built with flash RAM chips instead of tape drives to increase durability. Digital cam-

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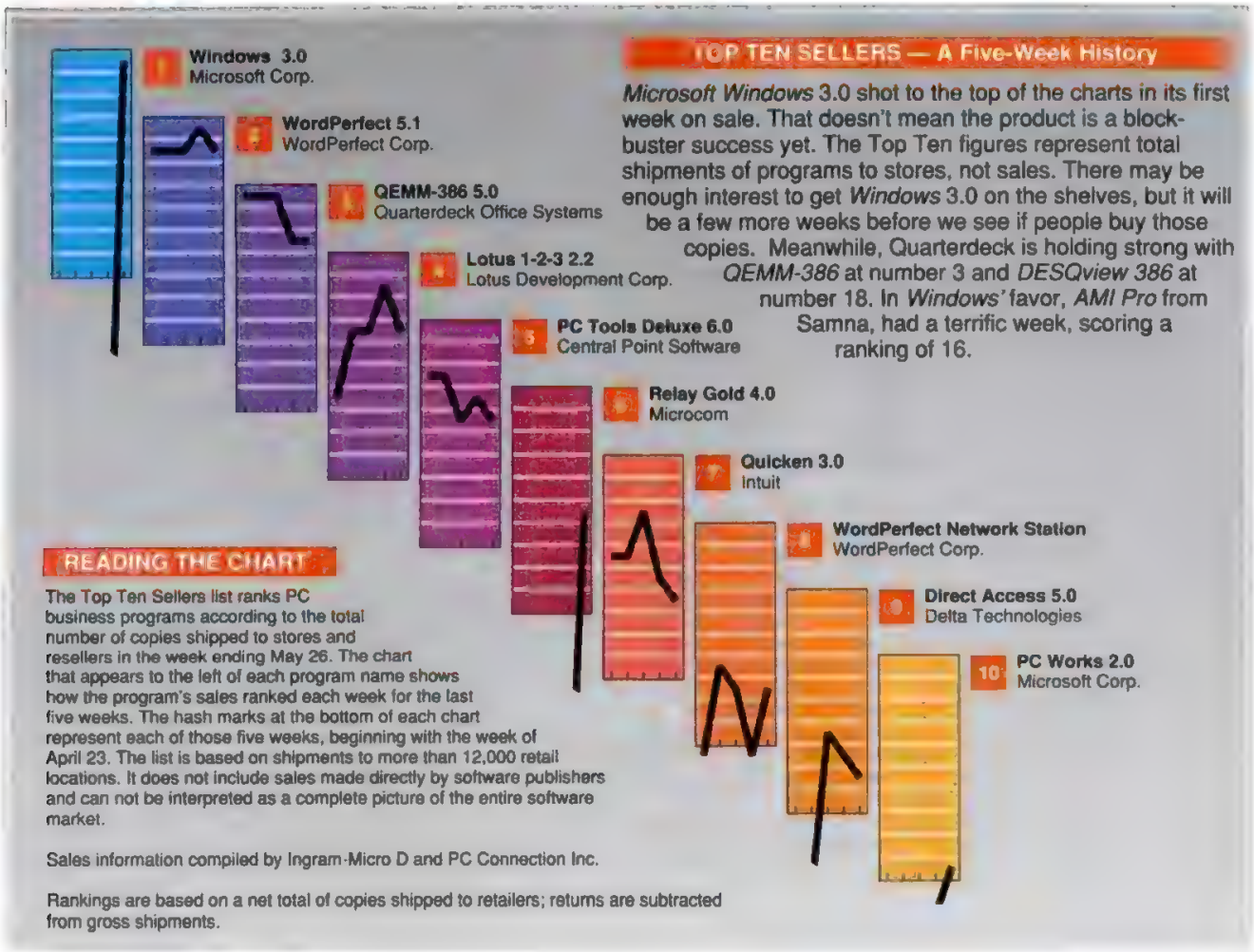


Pipeline

CONTINUED FROM PAGE 63

eras that use flash RAM for storage are likely. And Delco has announced plans to use the chips in car ignition systems by 1993.

The uses in a PC are also varied, though ROM replacement is probably going to become the most significant. NCR is already using flash RAM in place of ROM chips for storing the system BIOS in its new 486, the PC 486/MC33. NCR calls the technique a "software upgradable BIOS," and the appeal is obvious. Glitches and bugs in a BIOS can be easily fixed with software distributed on disk or by modem. Extensions to the BIOS for peripherals could be added as needed.

This view of Neptune's moon Triton was captured by Voyager II and was downloaded from the public bulletin board, Events Horizon.

Peripherals could also benefit from flash RAM for BIOS information. At least one maker of disk controllers is already designing a board that stores the device BIOS on flash RAM.

Digipro in Huntsville, Alabama is developing a line of nonvolatile RAM cards. Since flash RAM has read times comparable to dynamic RAM but requires 2 seconds for initialization whenever data is erased, flash RAM will not make sense as a hard disk replacement. Instead, it's likely to be used extensively for distributing and loading programs into memory. It will be most appealing in rigorous settings where vibrations and temperature extremes undermine hard disk reliability.

Flash RAM will be an ideal storage device where data is loaded into RAM and worked on for hours at a stretch. But in a more typical application, where files are opened and saved every few minutes, the initialization delay will be a problem.

That delay is not a factor when writing to a flash RAM chip that's not full; it's only encountered when data needs to be erased.

Flash RAM works by storing data as a trapped electrical charge; it's similar to the way that ROMs work but very different from dynamic RAM, which stores data as a charged capacitor. A flash RAM chip's "trapped charge" doesn't need any current to keep it active; dynamic RAM needs electrical refreshing constantly.

While flash chips can write data as fast as dynamic RAM, flash needs a little more time to empty out those charged cells by sending in an extra jolt of current to "jump over" the barriers that keep the charge in place. Intel guarantees the memory can be saved for at least 10 years.

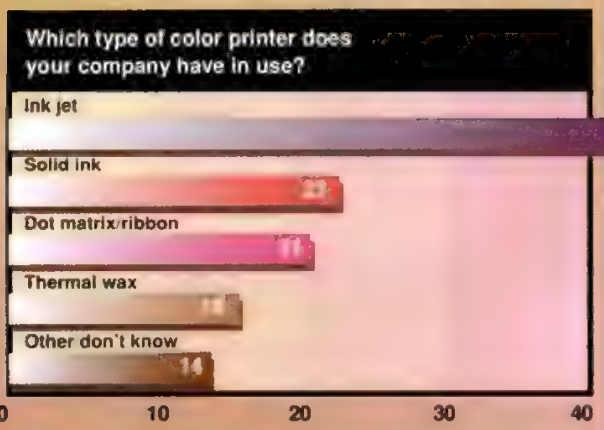
Meanwhile, Microsoft hasn't ignored the opportunity to make DOS the operating system for completely diskless PCs. It's already introduced the Microsoft Flash File System that will work with a ROM-executable version of MS-DOS.

It treats flash RAM storage like a disk, making the transition to a diskless operating system trivial.

Flash RAM may never totally replace the disk, but it will be able to do some of the jobs that disks can't.

PC MagNet SURVEY

While most of the world waits for color laser printers to be perfected, many people are already using color output. When we asked callers to PC MagNet about color printing, more than half of the 648 respondents said color printers were being used in their offices. We asked that group the following questions.



Photos from Hubble and Voyager II Available for Downloading

The next few months will be the most exciting and the most frustrating of times for amateur astronomers.

The newly launched Hubble telescope will start sending a stream of deep space photographs, and transmissions will be arriving from Voyager II that represent the first view of the earth and sun from the fringes of the solar system.

That's all heady stuff, but it's no fun to squint at the low-resolution, grainy reproductions in your local newspaper when new worlds are finally within sight.

Events Horizons, a public bulletin board, is posting the images in .GIF format as they're released by NASA's Goddard Space Center. Distribution of most of Hubble's photos will be restricted to scientists, but some will be released; two are already available for downloading. Selections from Voyager II's panoramic view of the solar system are expected by July.

The board sells download time at $10 an hour; disks are available for $39 each. Call (503) 697-7700 for voice information, or you can log on at (503) 777-1578 at N81. ■

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—InfoWorld, May 8, 1989

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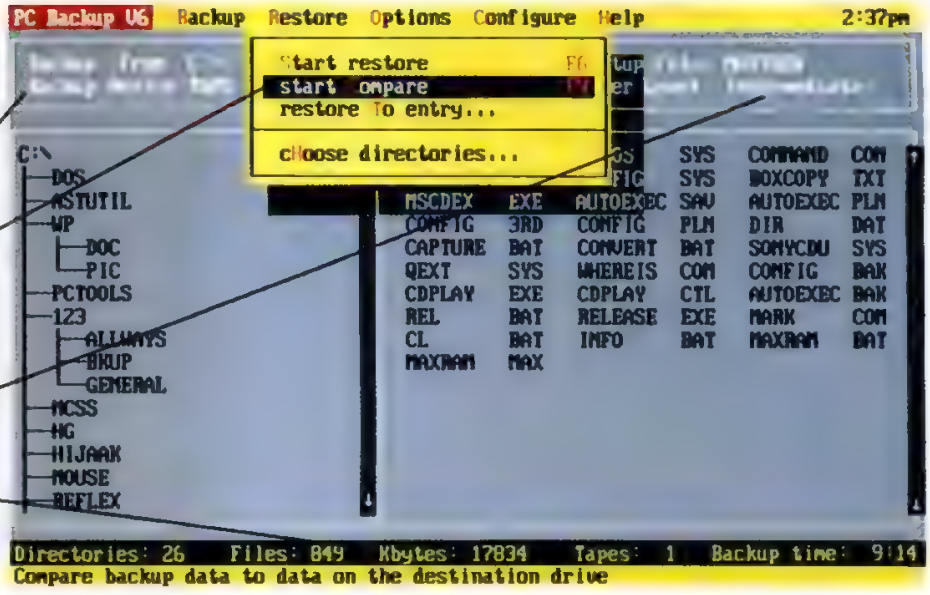
NEW **With three user levels,** *begin with the basics and add more advanced features when you're ready. (Also included in PC Shell™ below.)*

NEW **Fast and economical.** *Back up at speeds up to 2.5 megabytes per minute. Our new high-speed compression reduces disk/tape usage up to 60%.*



DOS Shell

"...a collection of utilities that you can use from the moment you turn on your computer to the moment you turn it off."
—PC Magazine, Jan. 16, 1990

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The critics agree: PC Tools Deluxe is the most advanced, comprehensive utility you can buy. In fact, Version 5 received about every editorial award imaginable in its class.

This year we're proud to announce PC Tools Version 6: over 70 new features that set new standards for technical excellence

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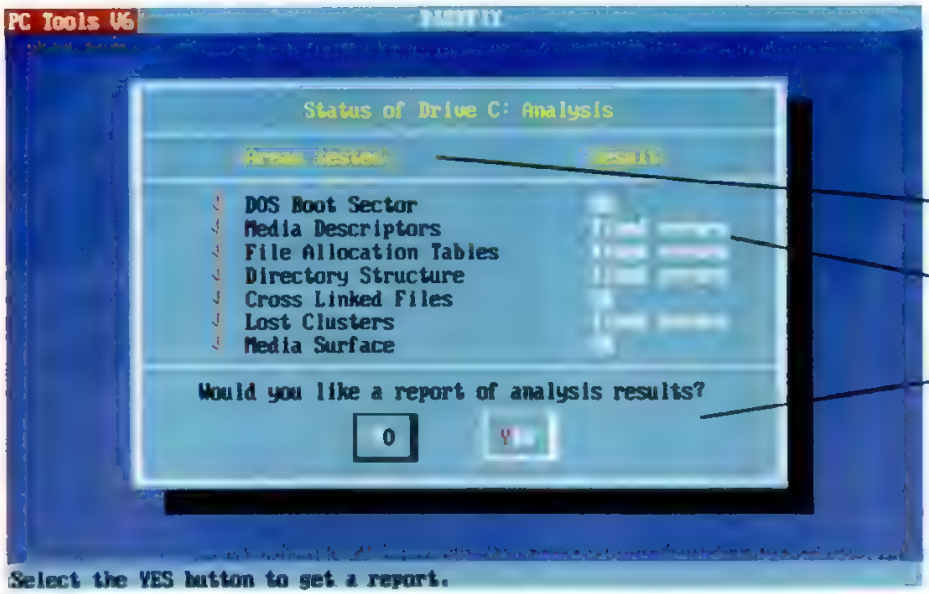
ugh for advanced users
h for beginners."

Ed Mendelson, PC Magazine "Best of 1989 Awards," January 16, 1990



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"... a complete system of file protection in one box."
—InfoWorld, Dec. 18, 1989

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NEW **Simple and automatic.** *DiskFix analyzes and repairs disks on its own. It doesn't ask you to become an expert.*

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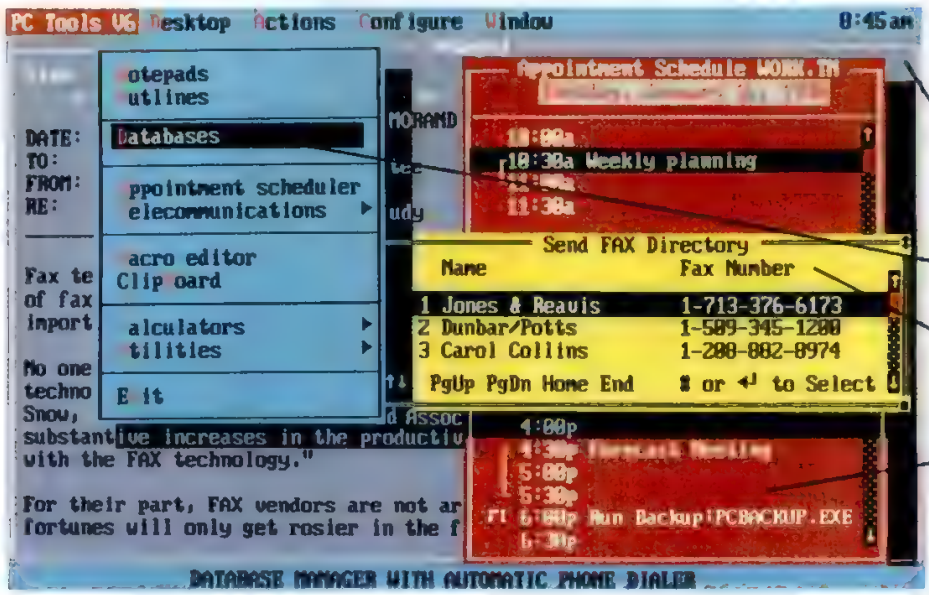

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—PC World, Jan. 1990

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- FoxPro gives you choices instead of limits: use a mouse or a keyboard; type commands or use the object-oriented interface; run in one window, or hundreds.
- FoxPro is so efficient, it runs in a 512K PC-XT, yet it's able to take advantage of the speed, expanded memory and extended video modes of the most advanced machines available. You don't even need a graphics card or special windowing software.

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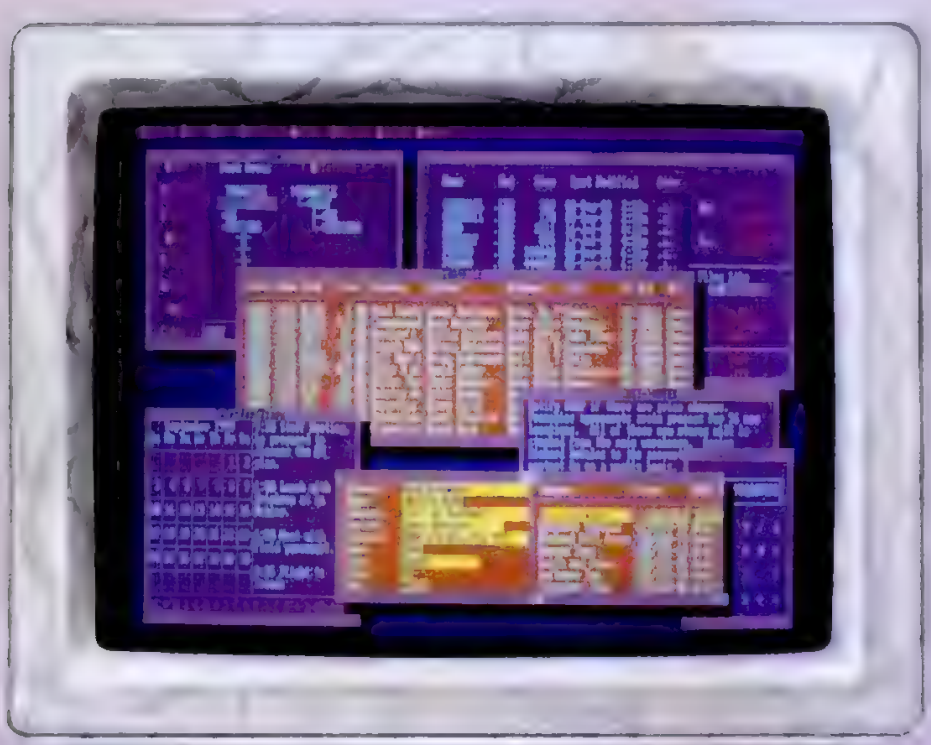

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System Requirements: *FoxPro operates in 512K RAM (640K recommended) with MS/PC-DOS 2.0 or greater and an 8086/8088, 80286 or 80386 microprocessor. For optimum performance, FoxPro takes complete advantage of any available EMS (expanded memory) or a math coprocessor.*

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Bill Machrone

It's Nice To Be Needed

When IBM rolls out a new product, it gets noticed. But without your help it might not succeed.

IBM wants you. It wants you to like its new home market machine, the PS/1. It doesn't necessarily expect you to buy one, but it needs your approval all the same. The PS/1 is the most carefully researched new personal computer ever, yet IBM is still dependent on many factors beyond its control, including your opinion.

Sure, Gus Venditto's review in this issue gives you all the vital statistics and draws some pointed conclusions about the machine's suitability to its intended market. You may want to take his word for it. You might hike on over to Sears or one of the other new dealers, have a look at it yourself, and draw your own conclusions.

IBM's goal is to meet or exceed the expectations of the potential home computer buyer. I say potential because up to now, there hasn't been much of a home computer market. You probably have a computer at home, but it isn't likely a home computer. Your primary use is extending the work day. After all, why sit in front of the tube after hours at work, when you can be in the den polishing the spreadsheet, tuning a database application, or learning new features, such as a macro language? We all know that it's too chaotic at work to focus in and really learn something new. So you hunker down at home and bring the benefit back to the office.

After the work is done, there's usually a line of family members waiting for a shot at the machine. Your spouse may have brought work home, too. Or there's the inevitable word processing and desktop publishing for clubs, churches, schools, etc. You might manage a mailing list or some financial records. If you have kids, there are the inevitable games and educational programs.

PC Magazine's readers probably have more computers at home than any other identifiable group. So all this is old hat to you. Meanwhile, IBM has identified 66 million households that can afford a PC. Not surprisingly, they're the same households that have upscale devices such as VCRs and microwave ovens. But they don't have a personal computer. What they do have is good intentions. This group really *wants* to buy a PC, but has one or more objections or obstacles. Cost, ease of use, support, and meaningful applications are all considerations. But IBM found a much larger obstacle, especially to buying its machines: Dealers weren't open when the target audience wanted to shop.

Computer stores rarely have evening hours, and may only have limited Saturday hours. The target audience either hasn't heard about buying computers via mail order or doesn't know what to make of it. They've heard of IBM, however. They start with a strong intention to buy IBM, but are quickly frustrated in their attempts to even see one in the flesh, much less get a presentation on how it will work for them at home. IBM's researchers found that fully 70 percent of home computers are bought after 5 P.M. on Thursday or on the weekend. That's why the new machine is available in retail stores that stay open, places like Sears, Dillard's, and Dayton-Hudson.

Of course, the PS/1 is available through IBM's regular dealers, too. But they're going to have to scramble to get their share of the pie by reaching out to a new class of customer—one that hasn't shown much inclination to venture into computer stores. The current dealers are working against a simple fact: IBM's research says that home computer buyers want to buy a computer where they shop, not at a specialty store. And where they shop is Sears.

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NOT ALONE AT HOME

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was wide availability. Sales accelerate dramatically after a product is available in 5,000 or more locations. Below that, it's a specialty item. Now what vendor can you think of that has more than 6,000 outlets, its own brand of computer, and is open when you want to shop? Right. Tandy pretty much owns the hearts, minds, and wallets of a large number of home computer buyers, for good reason. But Tandy has trouble moving into more upscale markets for some equally good reasons. One is Tandy's decidedly mid-tech veneer, although it hides some fairly advanced thinking.

For starters, Tandy led with instant-on, DOS-in-ROM technology. It was the first DOS-oriented manufacturer to offer joystick ports and a three-voice synthesizer as standard equipment on its low-end machines. Tandy's *DeskMate* shell program is standard on most machines, giving its customers a consistent user interface, replete with simple, useful applications. Yet Tandy continues to regard VGA as an interesting notion instead of the irresistible force that it has become in today's computer marketplace. After three years, you'd think it would be more than an option.

Another limiting factor is the product split between the Radio Shack stores and Tandy Computer Centers. Tandy loses the cachet of having a broad product line and an upward migration path, since its computer stores keep computer store hours instead of consumer shopping hours. IBM has the opposite problem—convincing the world that it has machines suitable for home use. To that end, you should find yourself fairly well inundated with the "After 75 years at the office, IBM comes home" message.

Now then, what's your role in all this? IBM recognizes that there's a far more powerful force than all their advertising: your opinion. You, as an accomplished computer user, early adopter, and expert, can make or break a product through your recommendations. Remember that the cognoscente killed the PC*jr*, after all. Every Christmas, your friends and associates come to you and say, "You know about computers. What should I get for my family?"

IBM hopes you'll think warmly of the PS/1. ■

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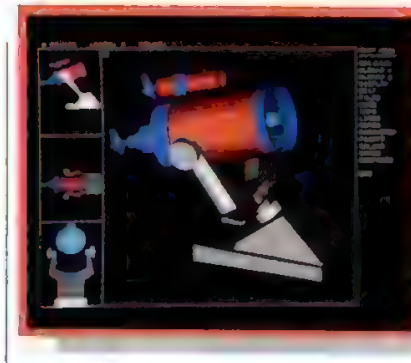

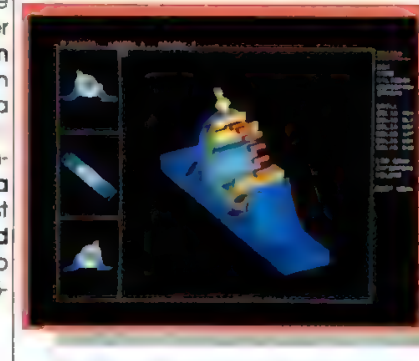

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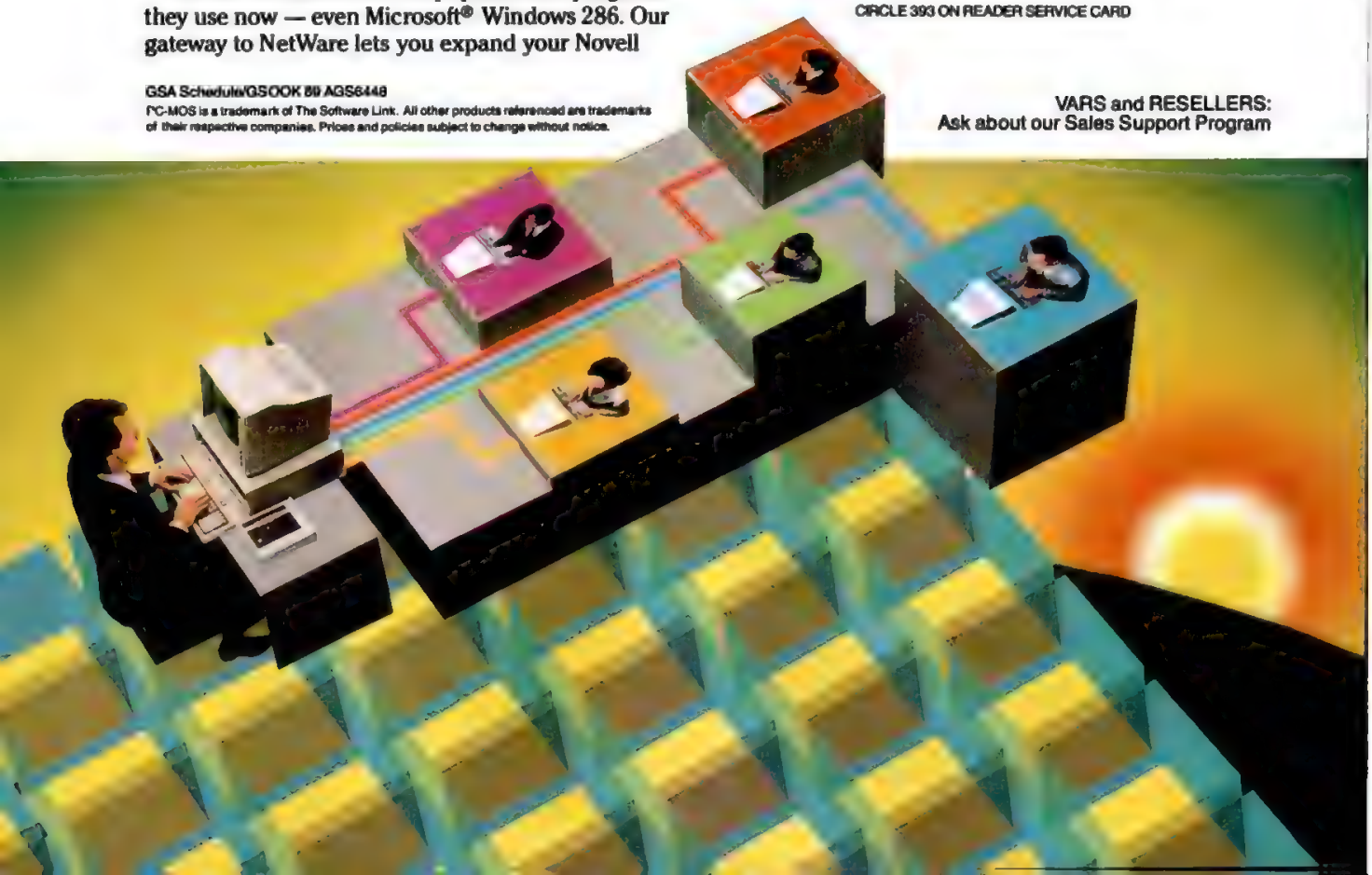

John C. Dvorak

Will Intel Corner the PC Market?

Monopolies never succeed in beating the market. But it's fun watching them try.

It's apparent that the 386 architecture will be the definitive CISC architecture of the 1990s. All upcoming Intel CISC processors are 386 chips in one way or another. The likelihood of a newcomer showing up and deposing Intel is nil. History tells us, though, that over a decade ago Intel was aced out by Zilog with its Z-80 chip. The Z-80 was a faster chip that contained the 8080 instructions and some of its own. It dethroned Intel overnight.

History repeats itself, but in this second go-round only one player remains. The bumblers at Zilog (and elsewhere) have failed to produce a popular microprocessor for this, the biggest market in computer history.

Unfortunately, PC manufacturers must confront the most significant problem facing the industry today: a single source for the critical component in all PCs.

Think about this for a moment. Assume that Compaq is having a board meeting. What will be the number-one topic at the board meeting? Do you think it might be that the company's entire $3 billion in sales is dependent on the whims of one supplier? Paranoia reigns at Compaq.

Let's take this a step further and imagine another board meeting, this one at Intel. First of all Intel knows that Compaq is worried sick about its microprocessor dependency. It also figures that Compaq isn't going to let this situation continue forever (unless the two companies merge—at which point all hell would break loose throughout the industry). Intel's continued growth depends upon maintaining itself as the sole supplier to companies like Compaq. What if Compaq decides to sneak away from Intel? Compaq already made the mistake of showing a "hole card" by investing in NexGen, a company vowing to clone the 386. What should Intel do? If the PC makers bail out, it will be left holding the bag (of chips). Paranoia reigns at Intel.

Intel can do one of three things: Do nothing and enjoy the view; second source the chips and make a lot less money, but keep its popularity; or make systems itself.

Intel has already decided to take the third approach. It began with Intel making machines for big OEMs like AT&T. Intel alone could easily bury big-time clone makers such as Acer and the other Taiwanese manufacturers.

Why shouldn't the company move into the next phase of its natural progression? Except for the disk drives, connectors, wire, and the sheet metal, Intel makes all the parts anyway. And its machines, though not branded "Intel" (yet), should work (theoretically) better than even an IBM. Intel should know these parts better than anyone, right?

There are already 50 million computers using Intel microprocessors. Would you be reluctant to buy the next generation machine from Intel itself at, perhaps, a substantially lower price than the competition? After all, with one layer of profit making taken out of the loop, the machines coming from Intel should be produced more cost effectively. Or would they?

Therein lies the rub. Intel used to make development systems years ago for the 8080 market. The same argument could have applied then, but the machines were overpriced and ridiculous. Maybe Intel learned a lesson and can

ILLUSTRATION: JEAN FRANCOIS ILLAUX

become the next Compaq—or even the next IBM. Maybe it can keep prices down, slaughter the competition, and bring us a $2,500 desktop Cray.

But by that point Intel will be in a monopoly position and, if my recollection of history serves me correctly, monopolies can't pull off such an act. Intel will be no exception, but I won't fault it for trying. Cornering the market is always an amusing thing to watch.

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John C.
Dvorak

Inside Track

Is **Clive Sinclair** about to make a comeback? The **famous** British engineer is said to be readying a **state-of-the-art** laptop weighing **less than 3 pounds**. His earlier effort used an 8-bit chip, wasn't MS-DOS compatible, and met with limited success. Sinclair, though, has the ability to redefine computing. His past successes included the first true pocket calculator in the early 1970s, then the Timex-Sinclair $99 computer, and a slew of other inventions. In addition to his **rumored laptop** there's talk about his designing a variable speed microprocessor. I was told that this chip would have a huge word size—something **like 96 bits.** I found this amusing since a few years ago when he released his 8-bit noncompatible laptop into a 32-bit world, he was asked by *San Francisco Examiner* reporter Paul Freiberger why he used an 8-bit chip. Sinclair replied, "Because I couldn't find a 4-bit chip that I liked."

> I would rather sacrifice the convenience of a hard disk and use "stripped down" software than lug the extra pounds.

Laptops, Laptops, and More Laptops, Dept.: Fujitsu has quietly announced in its company newsletter the FM R-50LX 386 **full-color laptop.** Supporting 10MB of internal memory, this machine will be one of a **barrage of color machines** that will be on the market by this time next year. Flat panel color technology is moving fast but there is still one major fly in the ointment: price. A price hasn't been set for the Fujitsu machine yet, but expect it to sell for more than $10,000—a price barrier few color machines will break. Hopefully, the yields on the flat panel color displays will improve, and prices will fall.

Unfortunately, the trend toward color keeps distracting people's attention from the idea that **no laptop should weigh more** than the NEC UltraLite—about 4 pounds.

There is an interesting phenomenon that a few *PC Magazine* staffers have experienced, myself included. Once you get used to the light weight of a machine like the UltraLite, you have difficulty rationalizing a move to heavier equipment. I would rather sacrifice the convenience of a hard disk and use **"stripped down"** software than lug the extra pounds. Most observers see laptop weight settling down to around 3 pounds someday.

Meanwhile, Toshiba, arguably the leader in laptop machines **despite its inability** to match the UltraLite for sheer lightweight elegance, is going one-on-one with its primary competitor, Compaq. A tremendous ad campaign highlights the keyboard and screen **superiority** of the new Toshiba machines over the **hot-selling** Compaq LTE.

These ads make it clear that it will still be awhile before Compaq decides that it wants to lead the industry rather than following the lead of IBM. This is reflected in its insistence on placing an **oversized Caps Lock** key next to the *A* on the keyboard, despite the fact that Caps Lock is seldom used and is **an annoyance** when accidentally struck. This location, of course, is where the Ctrl key belongs. Toshiba places the Ctrl key appropriately next to the *A*. The only reason that any keyboard designer puts the Caps Lock key next to the *A* is that IBM changed to **this dumb layout** a few years ago.

Unfortunately, my UltraLite has this same layout. To **correct this crime** I run a simple program called IBMFIX.COM, which is available free over PC MagNet by downloading from the Dvorak Library. This highly recommended utility seems to work on all machines; it reverses the Caps Lock and Ctrl key function.

An Idea Whose Time Has Come Dept.: If you want to toy with the 8514/A display, you can do it right on your VGA card. That's if you use the new RIXAI **8514/A emulation** program. For $100 this software driver will work on any extended VGA board. RIX Softworks can be contacted at 18552 MacArthur Blvd., #200, Irvine, CA 92715; (714) 476-8266.

RIX also has a **slew of utilities** that convert image files from Targa to VGA to EGA to CGA and back again. It's this ability to do high-resolution graphics conversion that led to the 8514/A emulator. This is a group of very talented people.

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Death Knell Dept.: It looks like the 286 has fallen on bad times. *PC Magazine* editor-in-chief Bill "386" Machrone once called the chip "brain dead," since it was obviously an interim chip leading to the 386—the chip of the nineties. But despite all the moaning, the 286 chip has managed to keep selling well—until now. The sale of the chip has finally **dropped below 386 sales** and planned purchases of the 286 are **falling rapidly.** Since all future designs of the Intel line will be better and better 386 chips with more and more on-board **features and bigger caches**, someone should be able to accomplish this Zilog-like feat in the next few years. ■

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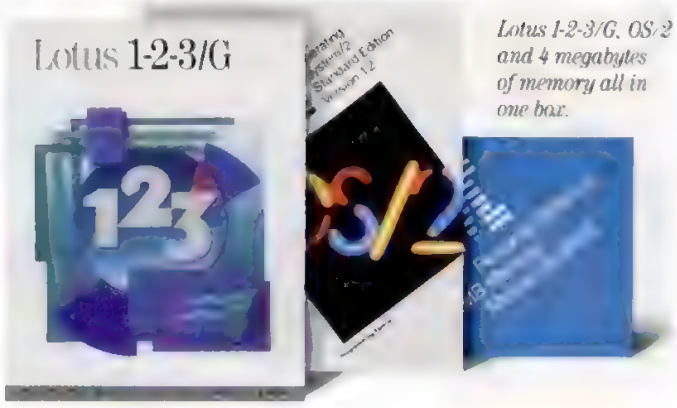
And to make it all worthwhile? You guessed it. Lotus 1-2-3/G.™ The spreadsheet that's so easy to use, and so exciting, PC World called it "a new high in spreadsheet technology."

Now one of the best reasons to get on a computer in the first place is the best reason to upgrade to OS/2.



Lotus 1-2-3/G, OS/2 and 4 megabytes of memory all in one box.

How To Get Everything You Need To Run OS/2 And Why You Should Even Bother.

The best part is that all of these things are available in one box. Under one roof (your local participating IBM authorized dealer). But only for a short time (from June 5th through August 31st). And at a price so attractive, you could wind up saving as much as $2000.

That information alone should get you to leap off the fence and dash out to buy a 1-2-3/G Bonus Pack.

◆

But for those of you who might not be ready to make the leap to OS/2, may we offer you some more reasons why you should?

Save a couple of grand when you buy them all together.

First of all, if you're a 1-2-3® user, 1-2-3/G will feel familiar, with menu commands and keystrokes you already know. But look a little closer. You'll begin to notice a lot that's new. Like full mouse support. Pull down menus. And dialog boxes. There's even a WYSIWYG display. And that's just the beginning.

We've also added features like previews and palettes in dialog boxes, dramatic new graphing capabilities and the capacity to directly move objects on the screen, making 1-2-3/G extremely responsive to the way you work.

The more you get to know 1-2-3/G, the more you'll like it. The advanced functionality helps you do better business analysis, with bonuses like file linking, network support, true 3D worksheets, and the new advanced goal-seeking technology of Solver.

Solver helps you solve complex "what if" problems by showing you "how to" achieve desired results. Rather than going through a lengthy trial-and-error process, just ask Solver to present you with alternatives, given whatever variables or constraints you define in your spreadsheet. It will not only give you a choice of solutions but will also point out the optimal one.

If you're a current 1-2-3 user, you'll be happy to know that all data and macros created in existing versions of 1-2-3 can be retrieved directly into 1-2-3/G. So a move to OS/2 will only serve to enhance any investment you may have already made in 1-2-3.

IBM

But how does OS/2 make 1-2-3 better? Well, besides introducing 1-2-3 to a graphical environment, OS/2 works harder and faster, so 1-2-3 can work harder and faster for you.

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With OS/2, 1-2-3/G can give you Dynamic Data Exchange. DDE provides live links to other Presentation Manager™ applications for true application integration.

For example, you can include a graph from 1-2-3 in a word processor document. And when the data in your graph changes, the word processor document will automatically be updated as well.

What's more, we've made sure 1-2-3/G complies with IBM Systems Application Architecture. Which not only makes its interface consistent with other PM applications, but also means that once you know how to use 1-2-3/G, you'll be able to learn other PM products more rapidly.

◆

At this point, you're probably thinking, "Enough, I'm convinced." But just in case, we'd like to bring you up to date on OS/2.

OS/2 1.2 is better than ever. And before long, no one will be without it. It's more than just a graphical environment for the PC. Or an operating system for a handful of power users. It's a high performance, easy to use operating system that provides increased memory addressability and true multitasking.

Multitasking in OS/2 lets you get your job done more efficiently by allowing you to work with several applications at once, or even perform several functions at once. Instead of having to end one program before retrieving another, you can open as many OS/2 windows as you need, in any size. And not only view them concurrently, but also transfer data among them. You can also do things like print a spreadsheet and run Solver at the same time.

Plus, with a capacity of up to 16Mb of real memory, you can run larger, complex programs concurrently. And reliably. That means your computer is more efficient for you, not just more fun.

If you're worried that a move to OS/2 will mean sacrificing the investment you've made in DOS-based applications, this should put your mind at rest: The DOS compatibility mode in OS/2 allows you to run most of the existing DOS-based programs you already own. Which means the transition to OS/2 involves great gain, with no pain.

And don't think for a minute that we've forgotten about memory. We understand that the biggest obstacle to expanding your system's capabilities is the expense of expanding your memory. That's why we've included 4Mb of high quality, IBM memory in our Bonus Pack. If you're a PS/2® user, it's all you need to get up and running with OS/2 and OS/2 applications like 1-2-3/G.

4 megabytes of memory will give you plenty of room to operate OS/2.

◆

Now you've heard the whole story. The computer environment of the nineties is here. With an application to drive it right off the shelves. So don't waste any time. Call 1-800-447-4700 for the local participating IBM authorized dealer near you. And pick up the Lotus 1-2-3/G Bonus Pack, with OS/2 and four megabytes of memory, while you have the chance. After all, while the window of opportunity may be brief, IBM and Lotus have opened the door to the future.

Hurry to your local participating IBM authorized dealer. This offer won't last long.

Offer good through local participating IBM authorized dealers. Offer expires August 31, 1990.

The Lotus 1-2-3/G Bonus Pack

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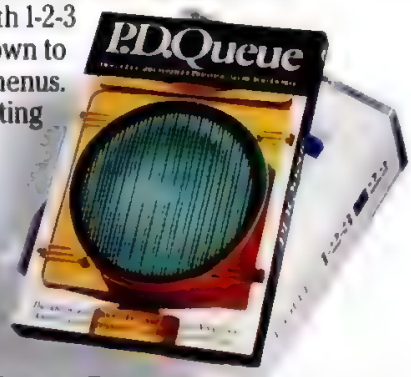

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CIRCLE 323 ON READER SERVICE CARD

Jim Seymour

Turning Software to Unexpected Tasks

Task-specific software can be very useful, and sometimes even essential. But don't be too sure that a more general-purpose tool lurking on your hard disk won't do the job just as well.

"Boy, I wish I had a program that could do that."

I hear that too often when I'm out visiting corporate clients and pull out a set of handouts I've prepared, or run through some overheads during a briefing, or unroll a time line for a project.

I'm flattered, of course, but frustrated, too, when that happens. Because often as not, the material was prepared with a very common program that was never meant to do that kind of work. Or, at least, that most PC users never *think* of when they need that kind of result.

I stand second to none in my admiration for smart, single-purpose programs. I rely heavily on *TValue*, for example, a wonderful little application for time-value-of-money calculations—though there's almost nothing you can do in *TValue* that you couldn't do in a spreadsheet, if at only one-fifth the speed. I wrote here in a previous issue about how much I rely on *Top Priority*, a to-do list keeper—though you could do as well with any word processor, if you had the time and patience. And I rely on *Books, Cards & Labels* to print out phone books from the database I've built within my auto dialer, *Hotline*—though I could get almost the same result if I worked over that file with the report writers in *dBASE* or *Paradox* for a day or so. And there must be another dozen special-purpose programs here that I make use of regularly.

Special-purpose tools are wonderful. And they can be great timesavers. *But you don't need a task-specific program for everything.* In fact, I often prefer a highly nonspecific software package. I think you might, too.

Those overheads my clients admire often came from plain, unvarnished *Microsoft Word*. Many of them, in fact, were produced quite some time ago with *Word* 3.0, which is by now either two or three major releases behind the times, depending on whether you count the company's new *Word for Windows*.

Most of the overheads I use are simple all-text titles and bullet lists, in 30-point Helvetica Bold. I can do that kind of work in a flash in *Word*—and have been for years.

Yet time and again I've heard clients bemoan their own inability to make similar foils, because they don't have a "desktop presentations" program.

Ditto for a lot of the handouts I use (which are often leave-behind copies of those overhead transparencies). Many of them came from *Word*, too.

THEN AND NOW

Time lines? I still produce preliminary project time lines the same way I did when I wrote here several years ago that what I really wanted—and had found—was an electronic equivalent of the back of an envelope, so I could sketch out a simple project chronology, or time line, then print it sideways on continuous-feed paper.

The program I used for those time lines then (and now)? *Lotus 1-2-3*.

It's incredibly quick and easy to construct a *Lotus* spreadsheet with a dashed line across the center, monthly or quarterly time-ticks along that scale, and text blocks of events floating above or below that line.

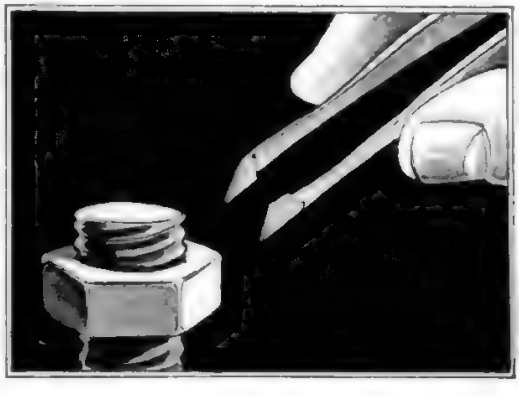

ILLUSTRATION: JEAN-FRANCOIS ALLAUX

Drop a vertical-bar character from each of those event descriptions to that time line and you've spotted the event precisely along that line.

Sure, full-fledged project-management programs are useful tools, and I use them, too—but not when I just want a quick, uncluttered, highly

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tentative time line to bring into a planning meeting.

After I construct the time line in *1-2-3*, I print it out sideways, using Funk Software's eponymous utility, on plain, wide computer paper, in large, bold type. I take that into a meeting, unroll it on the conference table, and all of us planning the project can walk back and forth, making our changes and additions. Or we pushpin it to the wall and pace back and forth, stepping back to consider the Big Picture, stepping in to note a detail.

Clients love it. So do I.

And they almost always ask where I found this amazing new program that can produce that kind of chart.

Sometimes, I use a specialized program of one sort to do specialized work of quite another sort. Over the past year, for example, I've become an avid user of Aldus's *Persuasion*, on the Macintosh. It turns out elegant 35mm slides quickly and easily; and yes, I confess I'm starting to use it for some overheads, too. (Watch for a DOS version of *Persuasion* later this year.)

But perhaps the most useful thing I do with *Persuasion* is produce organization charts. I formerly relied on a good org-chart-specific program—Banner Blue's *OrgPlus*—for this work.

But now I find I can produce much more elegant, typeset-like org charts, in much less time, by dipping into an obscure feature of *Persuasion*—in theory, a much broader, more generalized tool—rather than using *OrgPlus*.

THE IF-ONLY SYNDROME

I don't want to be retrograde about this. Certainly task-specific software can be very useful, and sometimes even essential. For the short list of things you do most often on a PC, you probably want a software tool optimized for just that job.

But when that occasional need for overheads, time lines, org charts, and other exceptions in your routine comes along, don't automatically fall into the "if only" syndrome, moaning that if only you had that great new program you read about last month in *PC Magazine*, you could do a great job.

Think about it a minute. You may have just what you need lurking on your hard disk. ■

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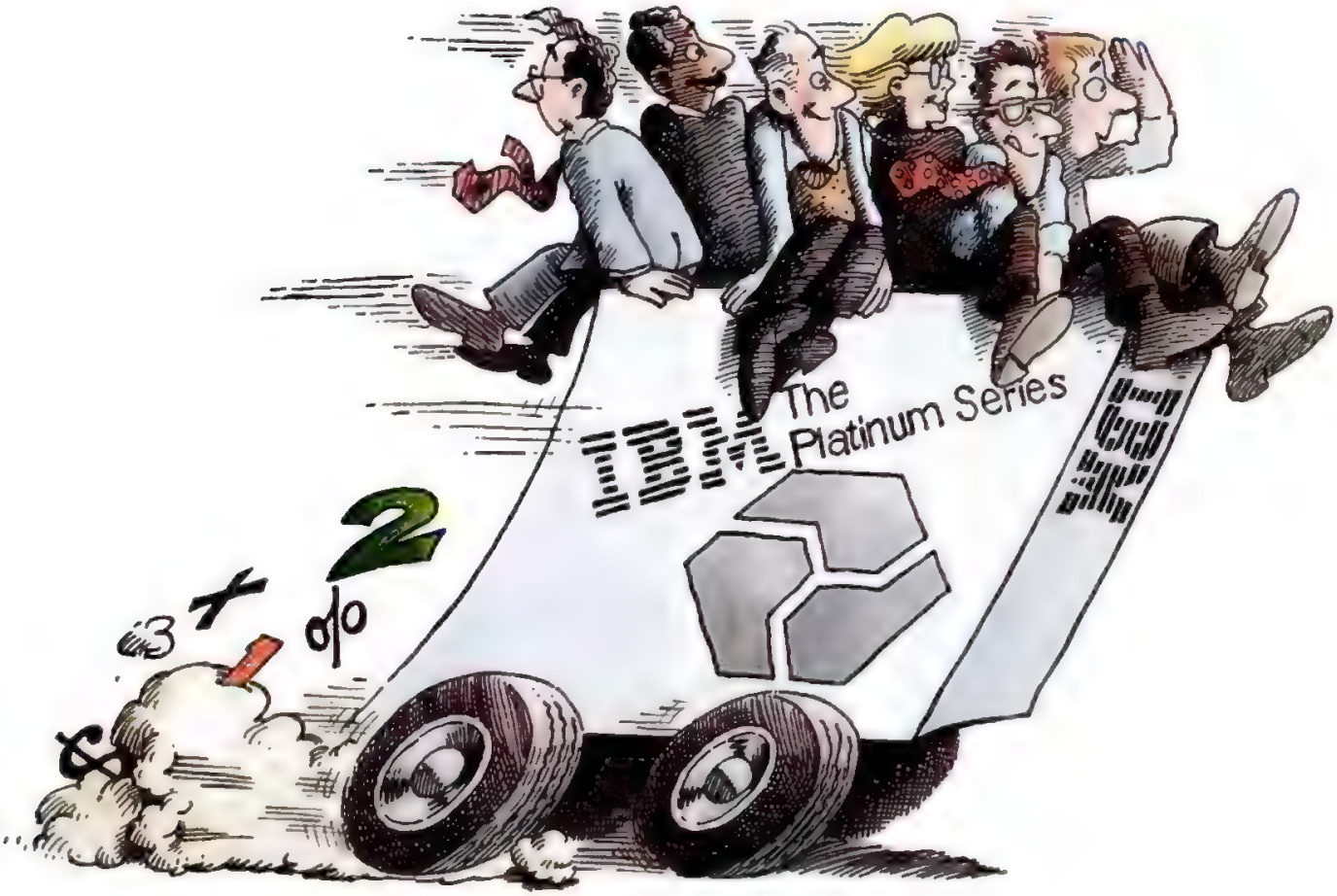

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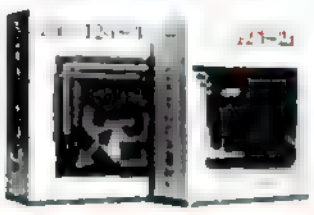

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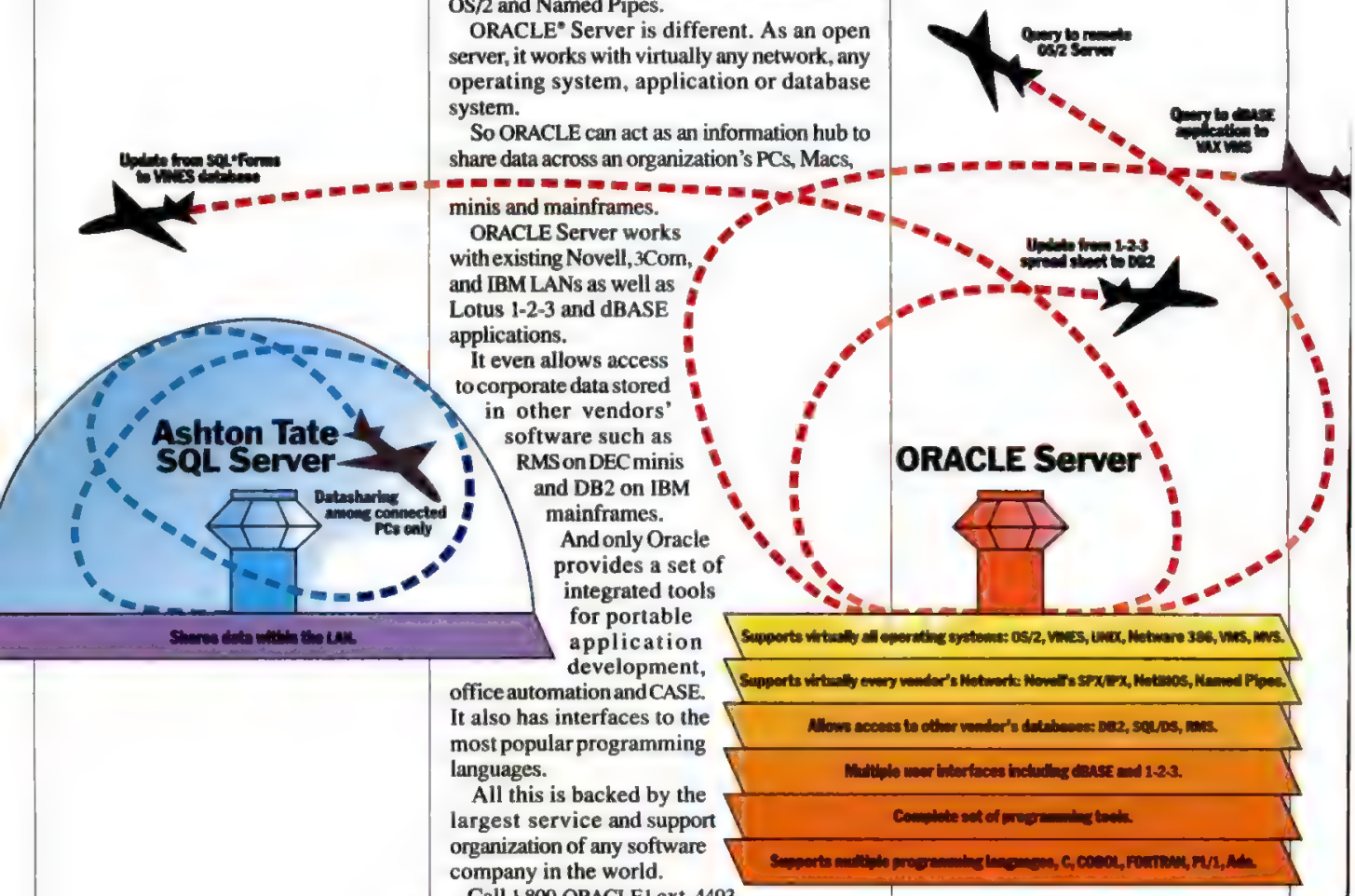

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William F. Zachmann

What's Sexy Versus What Works

Don't be quick to dismiss old, familiar development tools that get the job done. Newer tools may not give your company the competitive edge they promise.

Imagine two different companies, of roughly the same size, that compete for the same type of business. Both have a similar mix of networked 286- and 386-based PCs and a similar complement of mainframe and minicomputer systems as well.

Imagine that in one of these companies, all procedural level programming for PC applications is done in C, databases are all built using state-of-the-art SQL-based relational database management systems (DBMS) software, graphical user interfaces (GUIs) are used for all applications, and CASE and artificial intelligence/expert system software tools are used to the greatest extent possible.

Imagine that in the other company, the procedural language programming is done primarily in BASIC or COBOL, databases are built using *dBASE* or derivatives, nearly all applications are character mode, and CASE and artificial intelligence/expert system software tools are not used at all.

Imagine, too, that while the first company, as a matter of policy, makes extensive use of OS/2 and *Microsoft Windows*, the second does so only when there is a specific reason. Imagine that in the second company, products like *DESQview* and Digital Research's Concurrent DOS are widely used, instead.

Which of these companies will have the best, most cost-effective, most reliable, and most highly productive in-house systems? Which will derive the greatest benefit from its investment in PCs?

Were the benefits of all the latest, greatest software technology as certain as enthusiasts assume, there would be no contest here. The first company would be well on its way to destroying its more unfortunate and obviously very-backward competitor.

In the real world, however, matters aren't so straightforward. Chances are good that the first firm would have little or no advantage over the second. In fact, I suspect that the second company, relying on BASIC, COBOL, a *dBASE* derivative, and common sense might very well have the edge in information systems.

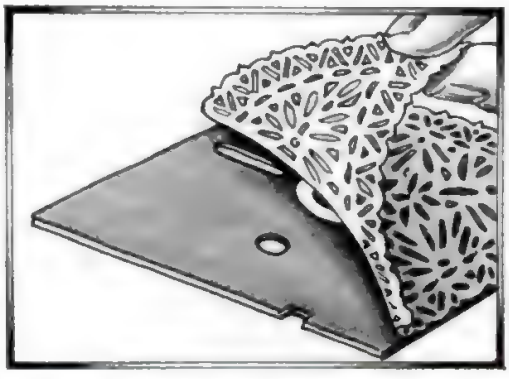
For, in the real world, it isn't a matter of how technologically advanced your tools are, but of how effectively you use them. Further, it isn't always true that what is most technologically advanced is always most useful, anyway.

IS NEWER REALLY BETTER?

I do not mean to suggest that there is no value in C, relational SQL-based DBMSs, GUIs, CASE and artificial intelligence tools, and new operating systems like OS/2. On the contrary, I not only prefer them, but I expect they will deliver substantial value in the years ahead.

Mere enthusiasm for the latest fads in technology, however, does not assure anybody of the potential benefits of that technology. Worse, excessive enthusiasm for new technology can all too readily lead one to underestimate the value of less spectacular but often more immediately useful alternatives.

Older, familiar tools in the hands of a skilled craftsperson can produce more effective results than can newer tools in inexperienced hands, even if the latter are more powerful and inherently easier to use. Only occasionally will a new tool be so much more effective that it will have an immediate advantage across the board.



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Moreover, the distinction between older and newer software tools and environments isn't nearly as sharp as the advocates of the latter assume (and claim) it to be. As innovations of real benefit are introduced in new products, they are often included in revised versions of older tools as well.

William F. Zachmann

The introduction of the program logic control structures necessary for structured programming into BASIC is just one of many examples of that. Numerous other capabilities, initially implemented in other newer languages have found their ways into recent versions of BASIC as well.

Similarly, as DBMS features have proven useful, they have found their way into *dBASE* either directly or in the form of enhancements to compatible products like *FoxBASE* or *Clipper*. The result is that the older products sometimes provide better implementations of useful capabilities than do their "more advanced" newer competitors.

The newer products sometimes suffer from significant disadvantages of their own. The greater generality of some of the newer software tools, for example, is often accompanied by greater overhead. That typically translates into more resource requirements, slower execution, or both.

Nearly all software that makes use of a graphical user interface, for example, is slower than character mode software given comparable system resources. In fact, it is only the substantial decreases in processing, memory, and storage costs over the past decade that have made GUIs an option for a large number of users.

Similarly, but even more significantly, relational DBMS software that implements SQL is virtually certain to be slower than more constrained DBMS packages. That may not be very important with relatively small databases, but can be a critical issue when implementing applications with large databases.

Then, too, the newer products generally come with a substantial learning curve of their own to climb. Mastery of any complex tool takes time. Under pressure to accomplish a task without time to learn new tools, we are often able to do the job better with the old ones.

SELLING IDEAS OR TOOLS?

Systems as well as software vendors with new products to sell often pitch their wares in the form of a "concept sell" aimed at upper management. The idea is to get management to buy the idea that, for example, relational DBMSs are automatically better, or that a particular CASE tool is necessary.

However, for the people who really need to solve the problem or get the new application system running, the concept bought by management may be far more a hindrance than a help.

Over time, though, the newer operating environments, tools, and techniques will provide a better foundation for developing information systems. But in the meantime, the moral of the story is not to be too quick to dismiss the continued contribution that more familiar and apparently less up-to-date technologies can make toward getting the job done. Just because a program is written in BASIC or COBOL, uses *dBASE* or a derivative instead of SQL, has a character-mode interface, and runs on DOS doesn't mean it can't be useful.

At the end of the day, it is the results that are important, not how technologically advanced the tools were that were used to get them. ■

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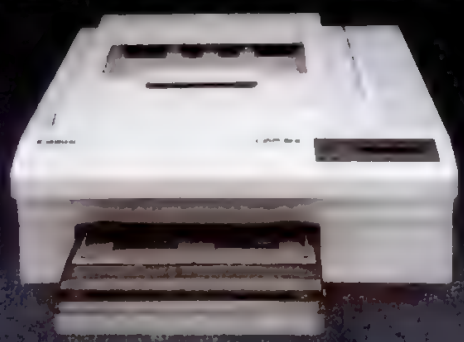

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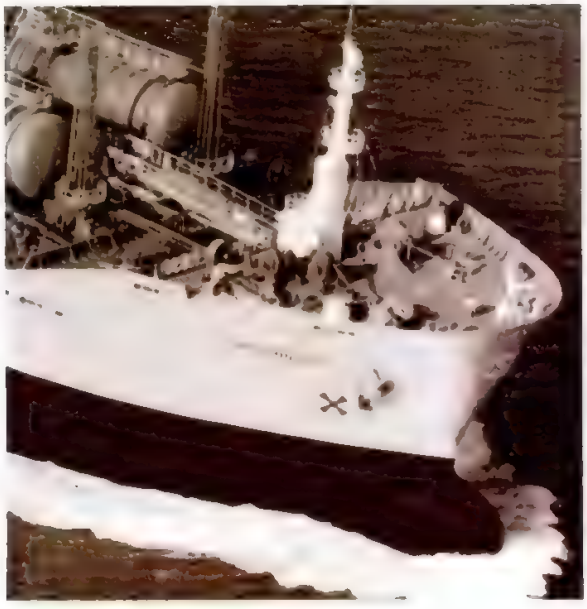

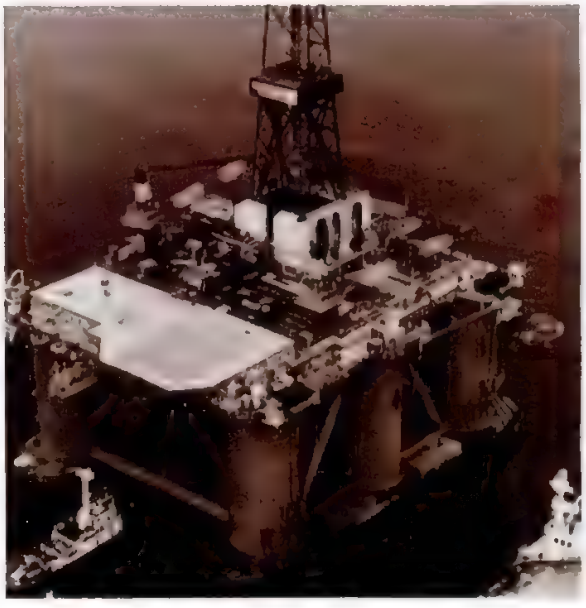

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The Cheapest 386SXs EVER

by Alfred Poor

Buying a 386SX system gives you access to the expanding array of 386-specific software packages, and it doesn't have to cost you more than a 286 machine would. PC Labs tests 21 low-priced 386SX machines that are helping to make the 286 obsolete.

Rapid change in the PC industry is what we have come to expect. Yesterday's miracle product quickly becomes old hat, and top-end systems that you dream about for a while soon look faded and tired compared with newer desktop dynamos. Changes at the high end of the performance scale often dominate the attention of industry observers, but the major upheavals in other segments of the market are not always apparent. In the midst of the hoopla over 486 technology and high-end 386 machines, the inroads that 386SX systems are making on the 286s' entry-level market deserve a closer look.

ILLUSTRATION DOUG ARCHER

PHOTOGRAPHY THOM O'CONNOR

While the top-performing PCs usually find their own customer base, millions of dollars are spent every year on less flashy machines that for many users are just as suitable. In this issue, *PC Magazine* looks at 21 of the lowest-priced 386SX systems. Running at 16 MHz, these computers will not keep pace with a hot new 486 design. On the other hand, you can buy a few of these low-end machines for the price of a single 486 system.

SIZING THE COMPETITION

The initial problem with evaluating SX units is fitting them into an up-to-date perspective of the larger market. They occupy a position where they compete with a number of other classes of computers, and weighing the benefits of the different designs—while factoring in ever-changing prices—can be difficult.

For example, one obvious rival for the 386SX is the 286-equipped AT-class machine. When it originally appeared, the AT featured a 16-bit processor with a 16-bit data bus. IBM first offered 6-MHz models but soon jacked up the speed to 8 MHz. The wider data path and faster processor blew away the slower 4.77-MHz 8088 PC and XT designs, but buyers wanted still more speed. Vendors responded to the demand with a series of performance increases, and 286 models now being sold often run at 20 MHz.

Intel designed the 386SX to give AT users a step up to a 32-bit processor with a 16-bit data path. Envisioned as an intermediate step between the 286 and 386 chips, it was touted to PC manufacturers as a way to make the engineering of a 32-bit machine as easy as designing a 286 unit. At the same time, it provided users with greater processing power plus the ability to run software designed specifically for the standard 386 (also known as the 386DX). Intel released the SX chip running at 16 MHz, the speed used by all the machines we review here.

The newest version of the SX chip is just beginning to appear in quantity. Running at 20 MHz, this high-speed version is destined to compete with the 16-MHz designs. Note that some vendors sell SX computers that come equipped with processors rated for 16-MHz performance but pushed to higher speeds such as 20 MHz. Since the manufacturer has not approved the chips for this speed, the practice is questionable. Intel has now released SX chips rated for 20-MHz operation, and these newer processors should not be confused with the "pushed" designs.

Full-blown 386 designs occupy the next higher rung. With a 32-bit processor and a 32-bit data path, these chips provide still better performance. Intel rated the first 386 chips for 16-MHz operation but soon offered faster versions; 20-MHz, 25-MHz, and even 33-MHz systems are now common. Competition has driven prices down so far that most vendors feel they have no room left to price a 16-MHz 386 model. As a result, most 386 computer lines start with the 20-MHz unit.

> The 386SX designs put pressure on both the fast 286 machines and the slowest 386 models.

Similar price compression is at work as a result of the growing market share held by 386SX designs. They put pressure on both the fast 286 machines and the slowest 386 models.

PRICE PRESSURES

To compare the prices of different designs, I selected ten mail-order vendors at random and compared their prices for identical configurations of 286, 386SX, and 386 computers. I used mail-order costs because the direct marketers give one another the stiffest pricing competition. Factoring in discounts is also easier for mail-order machines than for machines sold through dealers, since street prices and list prices can diverge markedly.

My results showed that the average price for a 16-MHz SX model is only about $170 more than the price of a 12-MHz 286 machine. The difference translates to less than 9 percent more for a machine that offers a faster CPU plus the advantages of a 386-family processor. Only three of the ten vendors in my sample listed 16-MHz 286 models; for those that did, the average price difference between 16-MHz SX models and their 286 counterparts came out to less than $100, making the SXs less than 5 percent more expensive.

From these prices, it is safe to assume that the SX models are one reason for the disappearance of 16-MHz machines. The 12-MHz and 20-MHz 286 also face tougher competition in the future from the SX.

On the other end, 20-MHz 386 machines average almost $500 more than 16-MHz 386SX units; this comes out to be about 20 percent more. Confronted with such steep price differences, buyers should ask themselves before they shell out the extra money whether they need the added performance of the full-blown 386DX and its higher clock speed.

The relation between costs and performance is not lost on American businesses. Two polls by *PC Week* indicate a strong shift in corporate buying plans. Last September, 386SX designs took a back seat, chalking up a 24 percent share of anticipated purchases, compared with 34 percent each for 286 and 386 machines (and 7 percent for 8086/88 models). By February—less than half a year later—SXs had moved up to the front: 39 percent of all planned purchases, with 386s close behind at 37 percent. The 286 had dropped back to just 22 percent, and the old 8088/86 designs were almost out of sight with only a 2 percent share.

MORE TO COME?

Two more factors coming over the horizon are bound to change this picture. Now that Intel has begun to release 386SX chips rated at 20 MHz, some sources predict that the price difference between the 16-MHz and 20-MHz chips could fall to as little as $50. SX models might then start to undercut the price of full 386 20-MHz machines, sending them into computing history to join their 386 16-MHz forerunners. The 20-MHz 386SX would fill the position of the entry-level business machine, with a 25-MHz 386 as the next step up.

On the other hand, industry rumor suggests that several chip manufacturers may start to produce their own 386-compatible processors. Up until now, Intel has chosen to keep the 386 design to itself rather than license it to other manufacturers, as it did with the 286. Its 386 monopoly has received the blame for supply problems in the past, and pressure in the marketplace is building for alternative sources for this important chip family. If new sources were to appear, the price for a 386 chip could drop. Cheaper 386 chips, in turn, would put new pressure on the SX machines; if a full 386 rated at 20 MHz were not significantly more expensive than an SX model at the

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• 1 parallel, 2 serial, 1 game port
• 14" color VGA monitor, 16-bit VGA card
your search for an affordable 20-MHz system could
• Enhanced 101 keyboard
• 80386, 25 MHz upgrade available ($200 additional)
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• 486 EISA; now shipping
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EDITORS' CHOICE

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Whether it's your first PC, or your latest, you'll find the features you ought to be looking for in these affordable new Panasonic® 286- and 386SX-based systems.

Both systems offer configurations complete and ready to run. With DOS, monitor, high-capacity floppy drive, hard drive and multiple expansion slots. Not to mention built-in graphics for VGA or SuperVGA.

Both systems offer enough memory, speed and flexibility to run business applications as well as your favorite computer games.

	RAM	Floppy Drive	Hard Drive	Built-in Display Adapter	Mono Monitor	Color Monitor
FX-1800	1Mb	1.44Mb		VGA		
FX-1800MSYSHD	1Mb	1.44Mb	40Mb	VGA	VGA	
FX-1800CSYSHD	1Mb	1.44Mb	40Mb	VGA		VGA
FX-1925S	1Mb	1.44Mb		SVGA		
FX-1925SMSYSHD	1Mb	1.44Mb	40Mb	SVGA	VGA	
FX-1925SCSYSHD	1Mb	1.44Mb	40Mb	SVGA		VGA

Both systems offer several configurations, so you get exactly the computer you want.

And both come with the security of Panasonic's 1-year limited warranty on both parts and labor.

The real value, though, lies in getting the technology you want, from a company you know. That's the Panasonic approach to Office Automation.

For more information on the 12Mhz 80286-based FX-1800 with built-in VGA or the 16Mhz 80386SX FX-1925S with built-in SuperVGA, call toll free: **1-800-742-8086.**

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same speed, the SX model would drop from sight.

For the moment, the 16-MHz 386SX doubtless offers you the best value. The machines reviewed here cost about the same price that similarly configured XT-level machines would have cost just a few years ago.

REVIEW CRITERIA

In previous issues we reviewed 386SX machines, most recently in a survey of 31 different models (see "386SX: The New Corporate Standard," *PC Magazine*, January 20, 1990). For the present issue, we wanted to report on the lowest-cost models we could find, as we did with inexpensive PCs ("The Cheapest PCs Ever," October 14, 1986) and PC ATs ("The Cheapest ATs Ever," February 16, 1988) when each in turn was the best bet for an entry-level business system. Now it is time for the 386SX version.

We selected the machines by contacting all the vendors we could find and asking whether they had 386SX systems that met our review criteria. To be accepted, a machine had to come configured with enough muscle to handle typical workplace applications. That meant including at least 2MB of random access memory, a 60MB hard disk, one high-density floppy disk drive (1.2MB or 1.44MB), and a color VGA display system. And all this had to cost no more than $1,850.

Many vendors market their systems directly through mail order, while a number of them sell through dealers who typically discount the list price. In order to place the machines that go through resellers on an equal footing, we applied a 25-percent discount to the list prices of those models sold through stores—which is why you will find some prices that are higher than our $1,850 limit.

The roundup includes comparative reviews of 21 386SX systems from ACMA, Amax, BroadAx Systems, CAF Technology, Computer Market Place, Coté, C^2

EDITOR'S CHOICE

• Micro Express ME 386SX

The SX PC is the entry-level system for the savvy computer user. It provides the base level of performance you need to run today's applications, especially *Microsoft Windows*, Version 3.0. We tested 21 80386SX machines selling for no more than $1,850, taking into account the expected discounts on machines sold through dealer channels. In general, we found these 21 were cheap but not cheaply made. The Micro Express ME 386SX merits our Editor's Choice designation. A small-footprint design, low price, and superior customer service and support policies weighed most heavily in our selection.

Small-footprint cases have become an increasingly desirable choice for users with little desktop space. Most SX-based PCs have this kind of design. Because more components can now be integrated onto the motherboard, including the parallel and serial ports and sometimes the video adapter, you can have a PC barely wider than your monitor that still has at least four free expansion slots and three drive bays. Small-footprint units provide enough room for a modem, a network card, and a bus mouse card. Compact and fast, these machines make great workstations for the bulk of your office needs.

The 16-MHz Micro Express ME 386SX fits the bill perfectly. It's 15 inches wide, well built, and one of the least expensive machines we tested. Our standard configuration for price comparisons requires at least 2MB of RAM, a 60MB hard disk, and a VGA display system. Micro Express's standard configuration delivered all this for $1,699 and included an extra 24MB of hard disk space. You can even purchase the company's 20-MHz SX for less than our $1,850 cutoff price. The company's warranty and service policies also impressed us, with a 30-day trial period, 15-month parts-and-labor warranty, and freight-paid parts exchange or optional next-day deskside service.

Four other machines deserve honorable mention: the Amax 386SX Business System, Gateway 2000 80386SX, Novas 386SX-16, and PSG 80386SX/16.

Amax Engineering Corp. shipped us the minitower model of the Amax 386SX Business System, but the same machine is also available in small-footprint and desktop cases. The minitower received only FCC Class A certification, so you would be wiser to purchase the other models, which earned Class B approval. At $1,655, the unit is one of the cheapest 386SXs you can purchase, although its one-year warranty and ship-to-the manufacturer service do not represent any advance over standard vendor policies.

Gateway 2000 has increased the size of its standard hard disk from 40MB to 65MB and lowered its price $300 since the last time we looked at its high-quality desktop 386SX computer. The company backs up the machine with a 30-day money-back guarantee, one-year parts swap by express mail, and on-site service if a problem can't be solved over the phone. Our tested unit came with a comparatively slow 65MB RLL hard disk from Microscience; you might want to move up to an ESDI drive if your typical applications are disk-intensive.

Economy of design and solid value qualify the Novas 386SX-16 from Novacor for honorable mention. Although you get only a one-year warranty, the quality of the minitower construction indicates Novacor's concern that its machine work for you over the long haul.

A relatively new entrant into the SX fray, Precision Systems Group offers its PSG 80386SX/16 in a sleek, small-footprint case and a discountable $2,295 price. For further reassurance, the company includes name-brand components in the machine and a two-year warranty.

Look for many of the machines we evaluated to be bundled in the near future with *Microsoft Windows*, Version 3.0. With the introduction of *Win 3* and the applications being released with it, 80386SX machines will be better able to take advantage of the multitasking abilities that a 386-type processor offers.

DATAWORLD LAUNCHES PORTABLE PAIR

Take off and go anywhere with this true 80386-20 laptop. With the built-in battery, you can be productive on flights to Sydney, Stuttgart, Tel Aviv or Taipei. Travel with the super crisp VGA display (LCD) as your companion.

Test one on your next flight or your next presentation. If you are not completely satisfied just return it within 30 days, no questions asked. We are just that confident!

Why buy a laptop computer if you can't carry it with you? You wouldn't buy a portable radio without a battery, so why settle for a portable computer without the most essential element of portability. And why sacrifice the honest-to-goodness 32-bit speed of a genuine 386 (as opposed to the 32-bit emulation employed by an SX machine). Now you don't have to! DATAWORLD introduces a bona fide 20Mhz 386 laptop with the battery built right in.

In addition to all of the standard features offered by the competition, the LP320 has an LCD/VGA screen, which displays in "paper-white" clarity and requires very little power to operate. Also, an advanced sleep mode feature prolongs the usable battery time per charge by letting the display, hard drive, and CPU hibernate when not active. That's better by far than the competition's touted perfect portable!

Portacomp III 386-25 $2955

For the power user, take along the new PORTACOMP III. This 80386-25 lunchbox portable with its VGA gas plasma display, full function keyboard and two full-size expansion slots makes an ideal remote base.

- VGA gas plasma display (640 × 480) with 16 gray scales
- 80386-25 processor
- 1MB RAM standard, expandable to 8MB
- 3.5", 1.44MB floppy drive (5.25" 1.2MB external floppy optional)
- 40MB, 25ms Conner IDE hard drive (80MB, 100MB, 200MB drives optional)
- 1 parallel and 2 serial ports
- 101-key keyboard with separate numeric and cursor keys
- 150W power supply (110/220V autoswitching)
- 2 full-length 16-bit ISA slots
- Carrying case

(SX also available)

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Now, at a price far lower than SX's with a battery indeed, priced in the same range as battery less SX laptops, you can own a real 386 (20MHz) portable complete with battery. With DATAWORLD, you don't need to sacrifice speed requirements to get portability or affordability. Look around if you like. There just isn't anything to compete with this value.

DATA LP/320 laptop $2595

- VGA backlit LCD display, 640x480 resolution with 16 gray scales. Built-in VGA port supports external VGA monitor
- 80386-20 processor, 80387 coprocessor support
- 1MB base RAM, expandable to 8MB on board
- 3.5" 1.44MB floppy drive (5.25" 1.2MB external drive optional)
- 43MB, 25ms IDE drive (80MB drive optional)
- 1 parallel and 2 serial ports; 1 half-length expansion slot
- Internal rechargeable battery with battery-level indicator light

DATA386-25E (VGA)

non-cache **$2895**

DATA386-25 (VGA)

64K cache **$3215**

DATA386-33 (VGA)

64K cache **$3550**

DATA486-25 (VGA)

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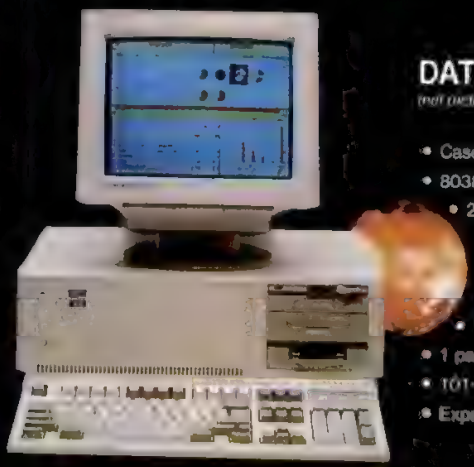

DATA386SX Super VGA slim-line

(not pictured) **$1995**

- Case (15.5"W×15.5"D×3.5"H)
- 80386SX processor
- 2MB RAM standard, expandable to 4MB on-board
- 5.25" 1.2MB or 3.5" 1.44MB floppy drive
- 40MB, 25ms Conner IDE hard drive
- 800 x 600 VGA adapter built-in
- 14" Super VGA color monitor
- 1 parallel and 2 serial ports
- 101-key enhanced keyboard
- Expansion slots: three 16-bit and one 8-bit available

- Memory: 4MB system memory standard, expandable to 16MB of 32-bit memory (DATA386-33 expandable to 40MB of 32-bit memory).
- EMS support: LIM EMS 4.0 software driver comes standard to support additional software such as Lotus 123, Desqview, WordPerfect, and Ventura Publisher, etc.
- Coprocessor supported: 80387
- Monitor: 14" Matsushita/Panasonic color VGA monitor supports 1024x768 resolution. Optional monitors include NEC Multisync 3D, 4D, or 5D.
- VGA adapter: 16-bit, 512K VGA adapter delivers 1024x768 resolution to MS Windows (286/386), Lotus 123, WordPerfect, AutoCAD, Ventura Publisher, etc.
- Hard drive: Ultra-reliable Conner 80MB IDE drive features 1:1 interleaving and intelligent look-ahead buffering for solid disk performance. Optional IDE drives (80MB, 100MB, 200MB) and ESDI drives (150MB, 300MB, 600MB) are available.
- Floppy drive: A 1.2MB 5.25" or a 3.5" 1.44MB drive comes standard (both provide read/write compatibility with the lower densities).
- Keyboard: 101-key enhanced keyboard comes standard. Optional 102-key keyboard features left function keys.
- I/O ports: One parallel and two serial ports come standard.
- Optional tape drive: A 60/120MB streaming tape unit safeguards your precious data against the unexpected.
- Chassis: Heavy-duty, steel constructed case offers room for five half-height drive devices, complemented by a rock-steady, UL/CSA approved 200W power supply.

RELIABILITY
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PC MAGAZINE

DATA386-25 MAY 30, 1989

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We made our selections during a relatively short period in mid-spring 1990. The 386SX systems segment of the PC market is particularly volatile and responds rapidly to market factors such as fluctuating chip prices, competitor pricing, and even *PC Magazine* review selection criteria. After we had completed testing but before the article went to press, a number of vendors reported new prices that would have qualified their units for this review. We would have included Tri-Star Computers Corp.'s SX machine, for example, if the company had lowered the price earlier. Other manufacturers whose SX machines did not meet our price criteria included Altec Technology Corp., Austin Computer Systems, Bus Computer Systems, Commax Technologies, Computer Products United, Continental Technology, Gen-Tech, Master Info Systems, Tangent, Telemart, Transource, WAA (Network PC), and Wang Laboratories.

CUTTING CORNERS

As you might expect, vendors of the cheapest 386SXs often go a little light on the extras to keep their costs down. For example, major mail-order vendors often adjust their prices to include an on-site warranty service contract, which goes a long way toward calming any reservations buyers might have about purchasing by mail. But the machines in this review generally do not include on-site service. Instead, the vendors offer it as an extra-cost option, or they provide parts exchange via overnight or second-day service.

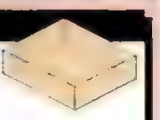
Don't expect to find too many other kinds of frills on these systems. Documentation tends to be minimal: often it's simply a collection of pamphlets from the component manufacturers. The software picture is stark; aside from setup programs and some fundamental utilities, everything costs extra. You're not likely to find DOS and *Microsoft Windows* 3.0 bundled with your system, as you might with higher-priced machines.

But if you're looking for a computer that will cost about the same as a 286 with similar speed, yet can run all the hot new software designed to take advantage of the 386 chip's capabilities, then the SX is the machine for you. And if you expect rock-bottom pricing with good value for your investment, then these are the computers to consider.

At least for the moment!

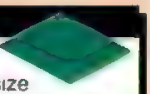
INTERIOR CONFIGURATION KEY

CASE



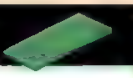
Cases typically come in five sizes: full desktop (shown here), three-quarter desktop, small-footprint, tower, and minitower.

MOTHERBOARD



Motherboards typically come in three sizes: full size (shown here), three-quarter size, and small-footprint size.

EXPANSION BOARD SLOTS



Different slots hold three different sizes of boards: one-half, three-quarter, and full size. A three-quarter-size slot is shown here.

POWER SUPPLY

Power supply options fall into four categories: large (shown here), medium, small, and long and narrow.

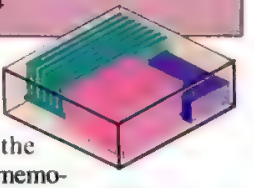
DRIVE BAY

Drive bays typically come in four different sizes: full-height (shown here), half-height, one-third-height, and 3.5-inch size.

ACMA COMPUTERS INC.

ACMA 386SX

by Bruce Brown



If you buy the ACMA 386SX, you'd better decide at the outset how much memory you'll eventually need, 2MB or 8MB RAM. All memory in the ACMA system plugs directly into the motherboard, using up to eight SIMM slots with either 256K or 1MB memory modules. You can't mix them; you have to use all 256K or all 1MB units. This is characteristic of the ACMA 386SX: you're not likely to jump for joy over its features, but with a little bit of planning you won't encounter many disappointments either.

If you're in the market for a standard 16-MHz 386SX machine, you need look no further than this small-footprint, ISA-bus machine. Its expansion capability, components, and service and support policies typify machines in its class. Performance falls a little below average, but so does the price—$1,939 for our tested configuration.

The tested unit included 2MB RAM, a 72MB Toshiba hard disk, both 1.2MB and 1.44MB floppy disk drives, a 16-bit OAK Technology VGA video adapter board with Hyundai color VGA monitor, one parallel and two serial ports, one game port, a 101-key Maxi-Switch keyboard, and DOS 3.3. The ACMA is 6.5 inches high by 17 inches wide by 16.75 inches deep.

Helm Engineering makes the ACMA's motherboard; Intel manufactures the 386SX chip set used on it. The motherboard contains a socket for an 80387-16 math coprocessor, which our tested system did not include. It came with an Award ROM BIOS, with setup in ROM and selectable shadowing for video and system ROM BIOS. It also used eight 256K 80-nanosecond SIMMs, for a total of 2MB RAM. To get the most from the system's page-mode interleaved memory setup, you should fill all eight SIMM slots. Again, if you intend to expand to more than 2MB RAM you should order the system with 1MB SIMMs, which will allow you to build to the system maximum of 8MB.

The ACMA contains a full complement of expansion interface card slots, with six 16-bit and two 8-bit full-length slots. Our tested configuration had five free slots, with individual slots occupied by the disk controller, video adapter, and I/O cards.

You can use up to four storage devices in the ACMA computer: three half-height devices and one 3.5-inch device mounted on its side fit inside it. The tested system arrived loaded with two floppy disk drives and a full-height hard disk, although you could use a half-height hard disk instead and still have enough room for an internal

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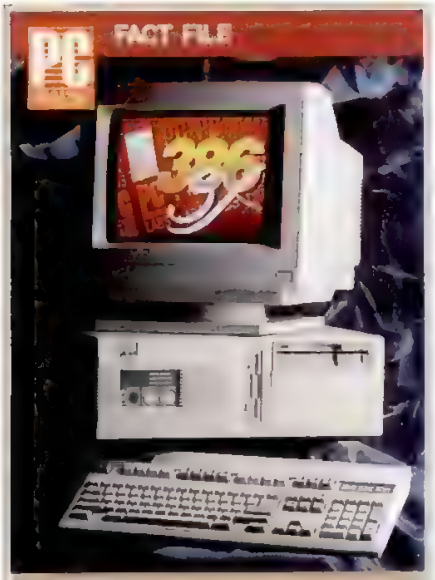


ACMA 386SX
ACMA Computers Inc., 117 Fourier Ave., Fremont, CA 94539; (800) 456-1818, (415) 623-1212; TDD (telecommunications device for the deaf) number: (800) 456-8901.
List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, $995; with 2MB RAM, 60MB hard disk, VGA monitor, DOS 3.3, $1,815; with 72MB hard disk, 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, $1,939.
In Short: The ACMA 386SX, a standard desktop system, performs slower than average but is available at a competitive price. The vendor provides a better-than-usual warranty but currently does not offer on-site service.

CIRCLE 416 ON READER SERVICE CARD

tape drive. The 200-watt power supply contains the four power leads needed for a four-drive system.

The ACMA performed worse than average on PC Labs' benchmark tests. In the Conventional Memory tests, its score was right in the middle of the machines we evaluated for this review. In all other test results—processor, hard disk, and video—it fell below average. The differences from average scores in the processor tests were hardly significant, but the disk and video scores slipped to among the slowest in this series.

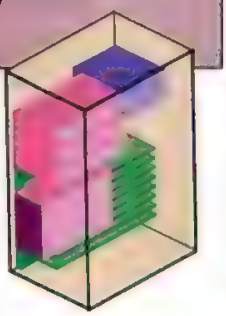
ACMA sells computers predominantly to end users, with only a small proportion of its sales going through value-added resellers (VARS) who bundle the machines with custom applications and other hardware. ACMA's warranty covers all parts for one year and labor for two years (the latter is twice as long as most other vendors offer). Currently no on-site service is available, though ACMA sources say they're negotiating for this option. If you identify a defective part within the warranty period, ACMA will advance-ship a replacement via second-day air delivery service. Once the new component is installed you send back the bad part. If you must send the computer to the manufacturer, ACMA pays for the return shipping, using the same shipping method by which you sent the machine.

The whole idea behind buying a 386SX machine is to have a computer that can run 32-bit software and give you entrance to the 386 world for a minimal amount of money. The ACMA 386SX offers a good selection of components for a relatively low price. It's an appropriate fit for the 386SX mold.

AMAX ENGINEERING CORP.

AMAX 386SX Business System

by Bill O'Brien



This may sound like anthropomorphism, but whenever I look at the Amax 386SX Business System, I can't help thinking that it's cute. It stands like some electronic Yoda in minitower form, puttering away at 16 MHz. Although its standard configuration costs $1,655, its basic configuration costs a minuscule $945 and includes 1MB of RAM, a 40MB hard disk, a 1.2MB floppy disk drive, and an ATI VGA Wonder card without a display. Except for its video hardware, most of the components included in the system put the 386SX Business System at the low end, but the machine overall performs excellently.

Even stretched out into a somewhat more usable configuration with 2MB of RAM installed, a 95MB hard disk, a 14-inch Seiko CM 1440 VGA monitor, DOS 4.01, and a mouse, the 386SX Business System is still priced reasonably at $1,735 (the monitor occupies $650 of that cost). The downside is that you can't contact Amax to buy one directly. Amax, being a distributor, does not sell to the general public, but you can find a dealer by telephoning the number in our fact file.

Once you've located an Amax machine, your system comes with a motherboard made by Helm Engineering. The manufacturer may not be well known, but the 80386 circuitry on the board derives from an Intel chip set and Award BIOS, and it is coupled with 80-nanosecond system RAM. The combination works, but not spectacularly. The 386SX Business System managed to come in around the midfield among the machines reviewed, showing reasonably good relative results on PC Labs' Conventional Memory and Floating-Point Calculation tests and a slightly slower score on the 80386 Instruction Mix.

We had difficulty assessing the computer's hard disk performance, however. The unit performed outstandingly on our disk tests, but we found that the machine we reviewed contained a CDC 95MB ESDI hard disk and a National Computer Limited controller. While Amax does distribute a number of ESDI disks, the CDC unit was not among the ones on the price list we received. The basic-configuration machine is supposed to contain a 40MB MFM Toshiba hard disk, and the MFM technology would certainly run slower than an ESDI disk drive.

Amax 386SX Business System
Amax Engineering Corp., 47315 Mission Falls Ct., Fremont, CA 94539; (800) 888-2629, (415) 651-8886.
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, VGA adapter card, one parallel and two serial ports, game port, $945; with 2MB RAM, 60MB hard disk, VGA monitor, DOS 4.01, $1,655; with 95MB hard disk, mouse, $1,735.
In Short: A great first computer for a tight budget, the Amax 386SX Business System in its basic configuration works like a midrange performer, but with a different selection of components, it can easily be bumped into higher levels of performance.

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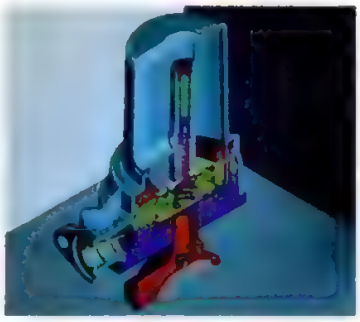

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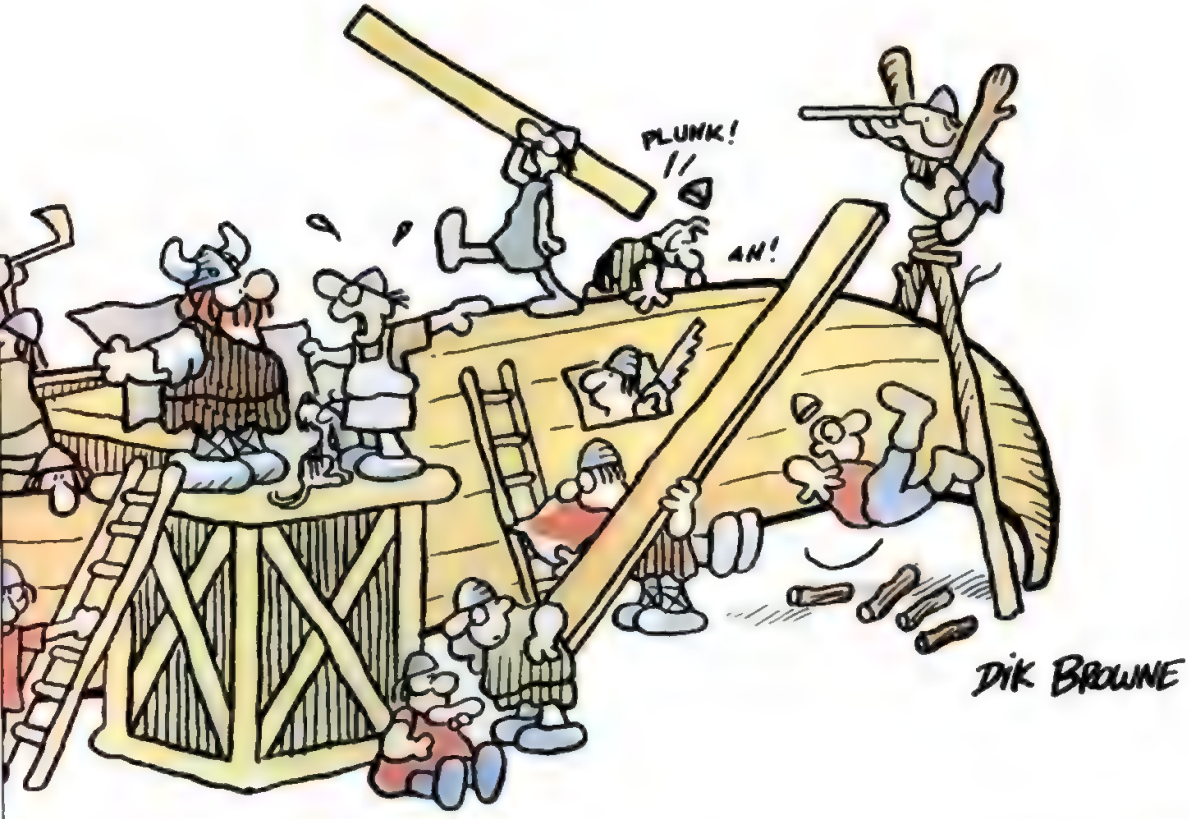

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The 386SX Business System's video provides one of its bright areas. The Seiko 1440 VGA monitor looks superb, even though it raises the price of the computer considerably. If you want to pamper your eyes it's an excellent choice; if not, your Amax dealer can arrange for a less expensive model. Likewise, the ATI Wonder VGA card showed little hesitation in supplying the video console with images; it responded well to our video benchmark tests. And the overall result, especially when scrolling, should improve if video BIOS shadowing is turned on. PC Labs disables all shadowing before testing the machines.

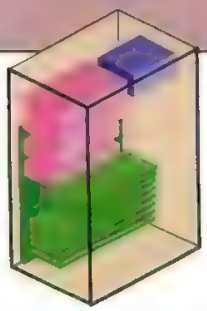
Like the motherboard, the keyboard takes a flight into currently unfamiliar regions, being the product of the Monterey International Corp. The 101-key keyboard with 12 function keys offers very good action, except that its key switches give you a tiny bit too much audible feedback. Amax also makes other keyboards available, including a no-click version if you prefer the sound of silence.

The Amax 386SX Business System, taken as a whole, appears to be an excellent low-end SX machine. In minitower form it rates as an FCC Class A computing device, meaning that it generates some radio-frequency interference. The identical machine in a desktop or small-footprint enclosure arrives in Class B trim, making it a plausible starter choice for your office at home.

BROADAX SYSTEMS INC.

BroadAx BSI 386SX

by Bruce Brown



Good looks count, even with electronic equipment. BroadAx Systems' BSI 386SX computer comes in an appealing minitower case, measuring 13.75 by 8 by 17 inches. It can hold four storage devices (two half-height and two 3.5-inch format), all of which can use removable media. In addition to its pleasing appearance, the BSI 386SX performed beautifully on our benchmark tests and has a fairly competitive price. Its only shortcoming is a 90-day warranty for labor charges.

In our standard configuration, the BSI 386SX lists for $1,904, including 2MB RAM, a 65MB hard disk, a 1.2MB or 1.44MB floppy disk drive, a 16-bit video adapter (1,024 by 768 pixels maximum resolution) and CTX Color VGA monitor, one parallel and two serial ports, a game port, and DOS 4.01. Our tested configuration added a second floppy disk drive, for a total of $1,984. If you want to cut costs, you can buy the BSI machine in a regular desktop case with 1MB RAM and a monochrome video setup for $1,374, including the 65MB hard disk and DOS.

> The BSI 386SX was one of the fastest machines in this review, achieving top processor scores.

The component manufacturers represented in the BroadAx computer include several standard names: VLSI, AMI, Toshiba, TEAC, DTC, ATI, and Fujitsu. VLSI makes both the system motherboard and the 386SX chip set. The board limits the maximum memory expansion to 4MB—not an unreasonable limit for a 386SX, though in a few years you might well wish the top reached 8MB. To counter the 4MB limitation, the VLSI board is more accommodating than usual and allows mixtures of 64-kilobit, 256Kb, and 1-megabit DIP chips. Two sets of 1Mb Samsung 80-nanosecond RAM chips occupied the test machine. The VLSI board uses page-mode memory interleaving and can be set for either zero or one wait state. The standard AMI ROM BIOS includes setup in ROM plus RAM shadowing of system and video ROM BIOS instructions.

In addition to the space it offers for four storage devices, the BSI 386SX contains two 8-bit and six 16-bit expansion slots. A more than ample 200-watt power supply provides juice to the system with four drive power connectors.

The BSI 386SX was one of the fastest machines in this review, achieving top processor and memory scores and above-average timings on all our benchmark tests for hard disks and video displays. The memory and processor scores were so good that initially they raised some question about the machine's conforming to normal 16-MHz 386 design practices, especially since the LED digital speed indicator on the front of the case indicated speeds of "10" in normal mode and "20" in turbo mode.

The components proved to be standard, however, with a clearly imprinted 16-MHz processor, 64-MHz crystal (divide by four to get the maximum system speed), and 80-ns. memory chips. The benchmark tests also indicated that the BSI 386SX was running at 16 MHz. BroadAx reported that the digital display indicates not system clock speed but rather the machine's speed on the Landmark speed test—a fairly common test that shows how much a given processor's speed surpasses the 8088 CPU used in the original IBM PCs and XTs. This is the first time we've seen a speed indicator represent anything other than actual system clock speed; perhaps BroadAx ought to stick with standard practices. The computer is fast enough

PC FACT FILE

BroadAx BSI 386SX
BroadAx Systems Inc., 9440 Telstar Ave., #4, El Monte, CA 91731; (800) 872-4547, (818) 442-0020.
List Price: With 1MB RAM, 65MB hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, monochrome monitor, one parallel and two serial ports, game port, DOS 4.01, $1,374; with 2MB RAM, VGA monitor, $1,904; with 1.2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, $1,984.
In Short: The BroadAx BSI 386SX comes in an attractive minitower case at a competitive price. Its test performance is well above the norm. The one-year warranty covers parts only, with the warranty on labor lasting a meager 90 days.

CIRCLE 418 ON READER SERVICE CARD

386SX-BASED COMPUTERS: SUMMARY OF FEATURES

Standard configuration price For the sake of price comparisons, our configuration includes 2MB RAM, a 60MB hard disk or better, one high-density floppy disk drive, a color VGA video display, at least one parallel and two serial ports, a keyboard, and DOS. In some instances, manufacturers do not offer the exact configuration *PC Magazine* requested, but all 21 of the PCs reviewed here provide a reasonably close match for this list of requirements. Check each machine's fact file for a more exact indication of what is included at the quoted price.

Case type indicates whether each computer has a small-footprint, desktop, or tower design.

386 chip set manufacturer indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. Chip sets that employ VLSI (very large-scale integration) technology reduce the discrete component count, which in turn helps to reduce power consumption and increase component life. In some cases the computer uses discrete logic rather than a chip set.

The **system RAM arrangement** is the method in which memory is addressed. Remember that CPU speed is usually faster than conventional memory speed.

Interleaved memory increases processing speed by dividing the memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section goes through a refresh cycle.

Page-mode memory allows back-to-back memory accesses within blocks of memory called pages, avoiding wait states.

Row/column is the traditional method of accessing data at a memory address. RAM is mapped as a matrix, and a particular address is given using a row and a column number.

In *static-column* memory, once data is located at a specific column address, subsequent pieces of data are accessed or allocated to the same column. Because the column is "static," data retrieval is faster.

Wait states On the average, most machines run at between zero and one wait state. The figures printed here were supplied by the respective manufacturers.

Maximum installable RAM Separate rows indicate the maximum 32-bit memory possible on the motherboard and on a dedicated memory board, as well as the maximum size of the processor RAM cache.

RAM packaging (and rated speed) Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs.

The *dual in-line package (DIP)* is the traditional buglike computer chip sprouting 8, 14, 24, 40, or more metal legs (evenly divided between right and left sides).

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card, with a proprietary SIP connection. Similar to SIPs are *ZIPs (zig-zag in-line packages)*, in which every other pin connection is slightly offset, creating a zig-zag pattern.

Single in-line memory modules (SIMMs) consist of individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively. Combination chips (4x256Kb) are generally faster and more expensive.

The **BIOS version and date** can affect PC Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in ROM.

Shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed at the cost of 384K of memory from the first 1MB of system RAM. The ability to disable shadowing is important with some applications to resolve memory conflicts.

Hard disk interface Within the 386 PC environment, the three most common hard disk interfaces are *ST-506, SCSI (small computer system interface)*, and *ESDI (enhanced small device interface)*. ST-506 uses one of two data encoding methods, *RLL (run length limited)* and the older *MFM (modified frequency modulation)* scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. The MFM format uses nine such bits to store the same amount of data that RLL can store with only six polarity changes.

Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC AT controllers. A new interface that offers good performance at a lower price than ESDI or SCSI is *IDE (interface design enhancements)*.

Hard disk options The number of different hard disks the vendor offers for a machine is often indicative of how much customizing is available. We are listing what we believe are the most popular disk choices (40MB, 60MB, 80MB, 100MB, 150MB, 200MB, 300MB, 600MB, or the vendors' closest available models).

Bus speeds Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 MHz. Note that the Micro Channel bus operates at 14.5 MHz.

The **display circuitry** can be either on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled it prevents upgrades.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Software available For OS/2, the version number and list price are provided. DOS 3.3 or 4.01 is included as part of *PC Magazine*'s standard configuration for computers; it therefore is not listed here.

Disk caching software Some companies provide software to facilitate data retrieval from the hard disk. This software speeds overall system performance by anticipating what data the processor will need next.

An **expanded memory manager** is software that emulates the Lotus Intel Microsoft (LIM) expanded memory manager within the extended memory of a 386 or 386SX PC.

Coprocessor supported All of the computers we reviewed support an 80387-SX coprocessor; therefore this information does not appear in the table.

Switchable settings on the power supply are designed to permit a computer's use in both the United States and Europe.

Number of device connectors indicates how many internal storage devices the system can support without the use of Y cables (power splitters).

FCC certification class Two classes of FCC (Federal Communications Commission) approval, Class A and Class B, may be given to computers. Class A approval signifies that a computer has sufficiently low radio-frequency emissions for operation in a business locale. The more stringent Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

Distributed through dealers or direct Some machines are sold directly through mail order. When machines are sold by dealers, the purchaser may find discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high).

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The Microway NDP Fortran-SX and NDP C-SX compilers generate the best code to take advantage of your 386SX. They feature excellent global optimizations not found in 16 bit compilers, plus the ability to take advantage of the 4 gigabyte address space of the SX. In addition, our complete line of ancillary products, including symbolic debuggers, profilers, virtual memory, plotting packages, windowing packages, graphics libraries and the NAG numerics libraries, can save you hundreds of hours moving your mainframe code to the SX. We also support the dialects you need, like VMS Fortran and ANSI C with the MS C DOS and graphics extensions. However, the best feature of these products is their price, just $595 including the DOS Extender tools needed to run the SX in protected mode!

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386SX-BASED COMPUTERS: SUMMARY OF FEATURES

	ACMA Computers Inc. ACMA 386SX	Amax Engineering Corp. Amax 386SX Business System	BroadAx Systems Inc. BroadAx BSI 386SX	CAF Technology Inc. CAF Master 386SX/16	Computer Market Place Inc. Ultra 386SX	Coté Computers of Arizona Inc. Coté 386 Plus	C³ Microsystems Inc. C³ Microsystems 386SX
Price of standard configuration	$1,815	$1,655	$1,904	$2,170	$1,789	$1,785	$2,125
Hard disk capacity	60MB	60MB	65MB	80MB	65MB	60MB	66MB
TESTED CONFIGURATION							
Price of tested configuration	$1,939	$1,735	$1,984	$1,915	$1,789	$1,603	$2,220
Case type	Small-footprint	Minitower	Minitower	Desktop	Small-footprint	Small-footprint	Small-footprint
Dimensions (HWD, in inches)	6.5 x 17 x 16.75	17.75 x 7.5 x 15.5	13.75 x 8 x 17	6.5 x 19.5 x 16.75	6.75 x 16 x 16.5	6.5 x 17.25 x 16.5	7 x 15 x 16.25
Motherboard manufacturer	Helm	Helm	VLSI	CAF	ENDAT-SX	Deico	MBI
386SX chip set manufacturer	Intel	Intel	VLSI	Intel	Intel	VIA	Chips and Technologies
System RAM arrangement	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode
Wait states	0, 1	0	0, 1	0, 1	0, 1	.3, .7	0, 1
MOTHERBOARD MEMORY							
Installed RAM	2MB	2MB	2MB	2MB	2MB	2MB	4MB
Maximum installable RAM	8MB	8MB	4MB	8MB	8MB	8MB	8MB
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (80 ns.)	DIP (80 ns.)	SIP, SIMM (80 ns.)	SIMM (80 ns.)	SIMM (80 ns.)	DIP (100 ns.)
Chip size	256Kb, 1Mb	4x256Kb, 1Mb	1Mb	256Kb	256Kb	256Kb	1Mb
ADD-IN MEMORY BOARD							
Installed RAM	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Maximum installable RAM	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RAM packaging (and rated speed)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chip size	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BIOS							
BIOS version and date	Award 3.04 (June 1988)	Award 3.04 (June 1988)	AMI (September 1989)	AMI (April 1989)	Award 3.04 (June 1988)	Quadtel 3.04.03 (January 1990)	AMI (October 1989)
Setup in ROM	■	■	■	■	■	■	■
Password in ROM	❑	❑	❑	❑	❑	❑	❑
Video shadowing/Can be disabled	■/■	■/■	■/■	■/■	■/■	❑/❑	■/■
System shadowing/Can be disabled	■/■	■/■	■/■	■/■	■/■	❑/❑	■/■
HARD DISK							
Manufacturer	Toshiba	CDC	Toshiba	Conner	Seagate	Western Digital	TEAC
Disk capacity	72MB	95MB	65MB	40MB	65MB	40MB	42MB
Interface	ST-506	ESDI	RLL	IDE	RLL	IDE	IDE
Controller location	Card	Card	Card	Card	Card	Motherboard	Card
Controller manufacturer	NCL	NCL	DTC	Kouwell	Western Digital	Deico	Kouwell
Integrated floppy/hard disk controller	■	■	■	■	■	■	■
Drive bays	3 half-height, 1 3.5-inch	1 full-height, 3 half-height	2 half-height, 2 3.5-inch	4 half-height	3 half-height, 2 3.5-inch	3 half-height, 1 3.5-inch	3 half-height, 1 3.5-inch
Hard disk options	109MB (MFM); 40MB, 60MB, 72MB, 150MB (ESDI)	40MB, 72MB (ST-506); 300MB, 600MB (SCSI); 156MB, 300MB, 600MB (ESDI)	100MB, 200MB (IDE); 150MB (ESDI)	40MB, 80MB, 100MB, 200MB (IDE)	40MB, 80MB (MFM); 40MB, 150MB, 300MB, 600MB (SCSI); 150MB, 300MB, 600MB (ESDI)	40MB, 80MB, 100MB, 150MB (IDE)	80MB, 110MB (IDE); 80MB (SCSI); 150MB, 300MB, 600MB (ESDI)
FLOPPY DISK DRIVES							
Type	1.2MB, 1.44MB	1.2MB	1.2MB, 1.44MB	1.2MB	1.2MB	1.2MB, 1.44MB	1.2MB
Manufacturer	TEAC	TEAC	TEAC	TEAC	TEAC	TEAC	TEAC
EXPANSION BUS							
Bus speeds (MHz)	8	8	8	8	8	3.5, 7	8
Expansion slots	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	One 8-bit, six 16-bit	Two 8-bit, six 16-bit

■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

Dyna Micro Inc. Work Master 386SX	Express Micro Mart Inc EXP 386SX	Fortron Source Corp Fortron NetSet 386SX
$1,900	$1,818	$1,750
65MB	66MB	60MB
$1,900	$1,818	$2,295
Minitower	Small-footprint	Desktop
13 x 7 x 16	6.5 x 17 x 16.5	5.25 x 15.5 x 14.75
Fora	Superwave	Fortron
Intel	Intel	Chips and Technologies
Interleaved, page-mode	Interleaved, page-mode	Row/column
0	0, 2, 4	0
2MB	2MB	2MB
8MB	8MB	8MB
SIMM (100 ns.)	SIMM (80 ns.)	SIMM (80 ns.)
256Kb, 1Mb	256Kb	4x256Kb, 1Mb
None	N/A	N/A
8MB	N/A	N/A
SIMM (100 ns.)	N/A	N/A
256Kb, 1Mb	N/A	N/A
Award V. 3.04 (June 1988)	AMI (April 1989)	Phoenix 1.10.20 (January 1988)
■	■	■
❑	❑	❑
■/■	■/■	■/■
■/■	■/■	■/■
Seagate 65MB RLL Card DTC	Mitsubishi 66MB ST-506 Card Western Digital	Conner 80MB IDE Card Conner
■	■	❑
2 half-height, 2 one-third-height	3 half-height, 1 one-third-height	2 half-height, 1 3.5-inch
40MB, 80MB, (MFM); 150MB, 320MB, 766MB (ESDI)	120MB (ST-506); 40MB, 80MB (MFM); 80MB (ESDI)	40MB, 80MB (IDE); 150MB, 300MB, 600MB (ESDI)
1.2MB TEAC	1.2MB TEAC	1.2MB Panasonic
8 Two 8-bit, six 16-bit	8 Two 8-bit, six 16-bit	8 One 8-bit, three 16-bit

CONTINUES

without a possibly misleading speed indicator.

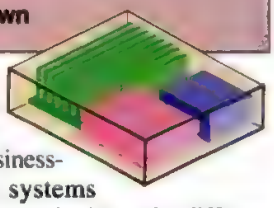
BroadAx Systems sells computers directly and through dealers. Currently more than half are sold through the dealer channel. The BSI 386SX comes with a stingy warranty: a full year on parts but only 90 days on labor. No on-site service contract is included, and if you need service you have to ship the machine to BroadAx's facility in El Monte, California. As of the testing date, the machine had no FCC sticker, so it was temporarily not available for sale. Class B certification has been applied for.

The BroadAx BSI 386SX is a compact system with reasonable expansion room. Its benchmark test speeds represent its best aspect, while the worst is the 90-day labor warranty. The price falls right about where it should. So if you like the unit's looks and performance and don't mind the limitations of 4MB maximum RAM and four storage devices, buy this machine and own one of the fastest 386SXs on the block.

CAF TECHNOLOGY INC.

CAF Master 386SX/16

by Bruce Brown



As 386SX machines take over the low-end niche of business-level PCs, the systems assembled from standard parts by different vendors become increasingly hard to distinguish. The CAF Master 386SX/16, from CAF Technology, provides one example of an SX clone that will do a serviceable job of running the new 386 software. Its scores are average or better on most of our benchmark tests; it costs more than the typical price, and it comes with a standard set of service and support policies.

Encased in a full-sized desktop design, the Master 386SX/16 measures 6.5 by 19.5 by 16.75 inches and bears an FCC Class A certification (office use only). Our "standard price" configuration requires a 60MB hard disk or better, but for the Master 386SX/16, the next step up is a Conner 80MB disk that brings the system's cost to $2,170. Our $1,915 test machine was configured with a 40MB 28-millisecond Conner hard disk, along with 2MB RAM, a 1.2MB TEAC floppy disk drive, 16-bit VGA Databyte Technology video adapter (1,024 by 768 maximum resolution) and CAF color VGA monitor, one parallel and two serial ports, game port, a 101-key Hi-Tek keyboard, and DOS 3.3.

While its prices are higher than for most of the 386SX machines sold by lesser-known vendors, they are actually subject to discount by the resellers through whom CAF Technology distributes its machines. All CAF systems come with a one-year parts-and-labor warranty, with service performed at the manufacturer's plant in Alhambra, California. If you have to send a system in for service, CAF pays for the return shipment using the same method by which you sent it. CAF does not provide an on-site service contract, but chances are good that you can obtain such a contract from the dealer who sells you the machine.

The motherboard in the Master 386SX/16 is made exclusively for CAF and includes an Intel 386SX chip set and AMI ROM BIOS chips. It can shadow both video and system ROM BIOS instructions, and a socket in the board con-

PC FACT FILE

CAF Master 386SX/16
CAF Technology Inc., 600 South Date Ave., Alhambra, CA 91803; (818) 289-8299.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, $1,195; with 2MB RAM, 40MB hard disk, VGA monitor, DOS 3.3, $1,915; with 80MB hard disk, $2,170.
In Short: The CAF Master 386SX/16 comes in a desktop case, and although it performs better than most, it has no particularly distinguishing features. Its price is slightly high, but discounts from dealers are undoubtedly available.

CIRCLE 419 ON READER SERVICE CARD

386SX-BASED COMPUTERS: SUMMARY OF FEATURES

	Gateway 2000 Inc. Gateway 2000 80386SX	HiQuality Systems Inc. HiQ386SX-16/20	Micro Express Micro Express ME 386SX	Mitsuba Corp. Mitsuba MIT-SXA	National Micro Systems Inc. Flash 386SX-16	Novacor Inc. Novas 386SX-16	Pan United Corp. PC 386/SX Business System
Price of standard configuration	$1,850	$1,960	$1,699	$2,295	$1,779	$1,850	$2,270
Hard disk capacity	65MB	65MB	84MB	67MB	65MB	60MB	60MB
TESTED CONFIGURATION							
Price of tested configuration	$1,895	$1,960	$1,699	$2,295	$1,779	$1,910	$1,995
Case type	Desktop	Desktop	Small-footprint	Small-footprint	Desktop	Minitower	Desktop
Dimensions (HWD, in inches)	5.75 x 21.25 x 16.25	6 x 21 x 16	7 x 15 x 16.25	6.5 x 17 x 16.75	6.5 x 19.6 x 16.5	17 x 7.5 x 16	6.5 x 21.75 x 16.5
Motherboard manufacturer	FTK	Chicony	Micro Express	Mitsuba	Chicony	Novacor	Amptron
386SX chip set manufacturer	Chips and Technologies	Intel	Chips and Technologies	Chips and Technologies	Intel	Intel	Intel
System RAM arrangement	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode, row/column	Interleaved, page-mode
Wait states	0	0, 1	0	0, 1	0	0, 1, 2	0
MOTHERBOARD MEMORY							
Installed RAM	2MB	2MB	2MB	2MB	2MB	2MB	2MB
Maximum installable RAM	8MB	8MB	4MB	5MB	8MB	8MB	8MB
RAM packaging (and rated speed)	SIMM (80 ns.)	SIMM (80 ns.)	DIP (80 ns.)	DIP, SIP (80 ns.)	DIP, SIMM (80 ns.)	SIP (80 ns.)	SIMM (80 ns.)
Chip size	1Mb	8x256Kb, 2Mb	256Kb	256Kb	1Mb	8x256Kb, 2Mb	4x256Kb
ADD-IN MEMORY BOARD							
Installed RAM	N/A	None	None	N/A	N/A	N/A	N/A
Maximum installable RAM	N/A	8MB	12MB	N/A	N/A	N/A	N/A
RAM packaging (and rated speed)	N/A	DIP (80 ns.)	DIP (100 ns.)	N/A	N/A	N/A	N/A
Chip size	N/A	1Mb	1Mb	N/A	N/A	N/A	N/A
BIOS							
BIOS version and date	AMI (December 1989)	AMI (March 1989)	Phoenix N1.10.20 (January 1988)	AMI (October 1989)	AMI (September 1989)	AMI (September 1989)	Phoenix 1.10.03 (January 1988)
Setup in ROM	■	■	■	■	■	■	■
Password in ROM	❑	❑	❑	❑	❑	■	❑
Video shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
System shadowing/Can be disabled	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
HARD DISK							
Manufacturer	Microscience	NEC	Quantum	Toshiba	Toshiba	Seagate	Seagate
Disk capacity	65MB	65MB	84MB	67MB	65MB	70MB	40MB
Interface	RLL	ST-506	IDE	RLL	RLL	RLL	MFM
Controller location	Card	Card	Card	Card	Card	Card	Card
Controller manufacturer	Western Digital	DTC	Micro Express	DTC	Western Digital	DTC	Western Digital
Integrated floppy/hard disk controller	■	■	■	■	■	■	■
Drive bays	5 half-height	5 half-height	3 half-height, 2 3.5-inch	3 half-height, 1 one-third-height	5 half-height	3 half-height, 1 3.5-inch	5 half-height
Hard disk options	40MB (RLL); 110MB (IDE); 110MB (SCSI); 150MB, 300MB, 600MB (ESDI)	40MB, 80MB (ST-506); 40MB, 80MB, 100MB (IDE); 110MB, 150MB, 330MB (ESDI)	40MB, 80MB (IDE); 150MB, 330MB, 750MB (ESDI)	40MB, 67MB, 80MB (ST-506); 150MB, 300MB (ESDI)	40MB, 80MB (MFM); 65MB (RLL); 100MB, 200MB (IDE)	40MB (MFM); 70MB (RLL); 40MB, 80MB, 100MB, 207MB (IDE); 158MB, 207MB, 360MB, 676MB (SCSI); 158MB, 360MB, 676MB (ESDI)	40MB, 80MB (MFM); 150MB, 300MB (ESDI)

—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.

PC Craft Inc. PCC 2260/16SX	Precision Systems Group Inc. PSG 80386SX/16	Tenex Computer Express Tenex 386SX HD VGA System	Treasure Chest Treasure Chest TC 386SX
$2,364	$2,295	$1,699	$1,659
60MB	80MB	65MB	65MB
$2,364	$2,295	$1,699	$1,599
Small-footprint	Small-footprint	Small-footprint	Small-footprint
6.5 x 16.25 x 16.5	6 x 13.75 x 15.25	6.5 x 17.5 x 16	6.5 x 17.25 x 16.5
PC Craft	Informtech	DTK	DataTech
Intel	Intel	Chips and Technologies	Chips and Technologies
Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode	Interleaved, page-mode
0, 1	0, 1	0, 1	0, 1
2MB	2MB	2MB	2MB
8MB	8MB	5MB	5MB
DIP, SIP (80 ns.)	DIP (100 ns.)	SIP (100 ns.)	DIP, SIP (80 ns.)
1Mb	8x256Kb, 2Mb	8x256Kb, 1Mb	256Kb
N/A	None	None	N/A
N/A	8MB	8MB	N/A
N/A	SIMM (100 ns.)	DIP (80 ns.)	N/A
N/A	1Mb	1Mb	N/A
AMI (August 1989)	Phoenix N.10.20 (1989)	DTK1 4.26 (January 1990)	Datatech 4.26 (December 1989)
■	■	■	■
❑	❑	❑	■
■/■	■/■	■/■	■/■
■/■	■/■	■/■	■/■
NEC	Conner	Seagate	Seagate
60MB	80MB	65MB	65MB
RLL	IDE	RLL	RLL
Card	Card	Card	Card
Adaptec	Conner	Western Digital	Adaptec
■	■	■	■
3 half-height, 2 3.5-inch	3 half-height	3 half-height, 2 one-third-height	3 half-height, 2 3.5-inch
40MB (MFM); 60MB (RLL); 110MB, 150MB, 330MB, 760MB (ESDI)	40MB (IDE)	40MB, 85MB, 105MB, 210MB (RLL); 345MB, 676MB (ESDI)	40MB (ST-506); 122MB (RLL); 80MB, 693MB (SCSI); 160MB, 328MB (ESDI)

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tains an 80387-SX math coprocessor.

The board uses a combination of SIMM and SIP memory module sockets for a potential total of 8MB RAM without employing a memory expansion card. Having both SIMM and SIP chip sockets is not unique to this motherboard, although it is the only one among the machines reviewed here that has them both. The small SIP sockets save space; otherwise there's no advantage to dedicating sockets to the SIP memory modules, and you may have a hard time finding them available for purchase.

As with the other machines that we reviewed, the CAF board makes no provision for memory above 8MB. What memory you can fit uses page-mode interleaving and runs at either zero or one wait state. Also on the motherboard are two 8-bit and six 16-bit expansion slots. The desktop case is oddly limited to four half-height devices, a surprising restriction given its large size.

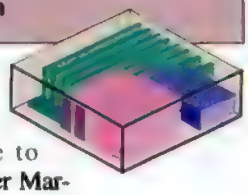
On PC Labs' benchmark tests, the Master 386SX/16 chalked up slow 80386 Instruction Mix results, a mediocre Floating-Point Calculation time, an above-average Conventional Memory score, fast disk timings, and extremely fast video performance. Overall, the machine is visibly faster than the average for 386SX computers.

The computer is a clone, but that's all right. If you can negotiate a good discount for a CAF Master 386SX/16, you'll find yourself with a decent representative of 16-MHz 386SX computing and a ladder up to 386-level software.

COMPUTER MARKET PLACE INC.

Ultra 386SX

by Bruce Brown



In the market for a 386SX? Then it certainly makes sense to come to Computer Market Place. This generically named computer company offers a good deal. Its Ultra 386SX, with an FCC Class B rating, comes in a small-footprint case measuring just 6.75 by 16 by 16.5 inches, but it contains space for five drives, eight expansion cards, and 8MB of RAM. Combine the expansion capability with very good pricing, better-than-average performance, and cus-

386SX-BASED COMPUTERS: SUMMARY OF FEATURES

	ACMA Computers Inc. ACMA 386SX	Amax Engineering Corp. Amax 386SX Business System	BroadAx Systems Inc. BroadAx BSI 386SX	CAF Technology Inc. CAF Master 386SX/16	Computer Market Place Inc. Ultra 386SX	Coté Computers of Arizona Inc. Coté 386 Plus	C² Microsystems Inc C² Microsystems 386SX
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	5	5	5	5	6	6
Ports originate on motherboard	❑	❑	❑	❑	❑	■	❑
VIDEO							
Display circuitry location	Card	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Manufacturer	OAK Technology	ATI	ATI	Databyte	Ztech	Trident	Shogun
Chip set manufacturer	OAK Technology	ATI	ATI	Trident	Western Digital	Trident	Gemini
KEYBOARD							
Manufacturer	Maxi-Switch	Monterey	Fujitsu	HI-Tek	Key Tronic	Key Tronic	Chicony
Number of keys	101	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12	12
Keyboard cable length (inches)	60	72	72	90	72	96	72
SOFTWARE AVAILABLE							
OS/2	None	1.1 ($699)	None	None	1.1 ($237)	None	None
Disk caching software	None	*PC Tools*, Version 6 ($109)	None	None	*PC-Kwik* ($89)	None	None
Expanded memory manager	None	*EMM386*, Version 4.2 ($199)	None	None	*QEMM* ($59)	None	None
Other	None	None	None	None	None	None	None
MISCELLANEOUS							
Physical features:							
Power supply (watts)	200	200	200	200	200	200	200
Switchable settings	■	■	■	■	■	■	■
Number of device connectors	4	4	4	4	5	4	5
Keyboard lock	Front	Front	Front	Front	Front	None	Front
Case lock	Front	Front	Front	Front	Front	Front	Front
Power-on switch	Side	Front	Front	Side	Back	Side	Front
Reset switch	Front	Front	Front	Front	Front	Front	Front
Warranty	1 year parts, 2 years labor	1 year	1 year parts, 90 days labor	1 year	1 year	18 months	1 year
Service	Return to manufacturer	Return to depot, dealer, or manufacturer	Return to manufacturer	Return to manufacturer	Express parts swap; on-site optional	On-site	Return to dealer or manufacturer
FCC certification	B	A	A (pending)	A	B	B	B
Distributed through dealers or direct	Direct	Both	Dealers	Dealers	Direct	Direct	Dealers

■—Yes ❑—No

tomer-oriented service policies and you might decide that Computer Market Place is indeed the best place to shop.

Our $1,789 test machine came equipped in *PC Magazine*'s standard configuration as requested. The tested computer included 2MB RAM, a 65MB Seagate 28-millisecond hard disk, a 1.2MB TEAC floppy disk drive, a 512K 16-bit Ztech video adapter (1,024 by 768 maximum resolution) combined with an Amazing color VGA monitor, one parallel and two serial ports, a game port, a 101-key Key Tronic keyboard, and DOS. If you want the cheapest possible complete system, you can cut it down to 1MB RAM, a 40MB hard disk, and a Hercules-compatible monochrome video setup for only $1,149. That price does not include DOS, which Computer Market Place sells as an $89 option.

The only brand name you'll probably not recognize is that of the motherboard, ENDAT-SX. This unit features an Intel 386SX chip set and Award Modular BIOS, with support for both video and system ROM BIOS shadowing and a socket for an 80387-SX math coprocessor.

The motherboard uses SIMM memory with an on-board maximum of 8MB. Either 80- or 100-nanosecond chips work. The tested machine included 80-nanosecond 256-kilobit Panasonic chips, filling the sockets to take maximum advantage of the board's page-mode memory interleaving capability. You can not mix SIMM sizes on the board, so if you intend to expand beyond 2MB RAM it makes sense to start with 1MB RAM modules.

Dyna Micro Inc. **Work Master 386SX**	Express Micro Mart Inc. **EXP 386SX**	Fortron/Source Corp **Fortron NetSet 386SX**
5	5	3
❑	❑	■
Card	Card	Motherboard
16-bit	16-bit	8-bit
Orchid	Sefco	Info not available
Tseng Laboratories	Trident	Cirrus Logic
Mtek	Focus	Fortron
101	101	101
12	12	12
64	84	72
None	None	1.1 ($299)
None	None	*PC-Kwik* (included)
None	None	None
None	None	None
200	200	145
■	■	■
5	4	5
Front	None	Front
Front	Front	Front
Front	Side	Front
Front	Front	Front
1 year	1 year	1 year
Send to depot; on-site optional	Ship to manufacturer; on-site optional	On-site
B	B (pending)	B
Dealers	Direct	Direct

CONTINUES

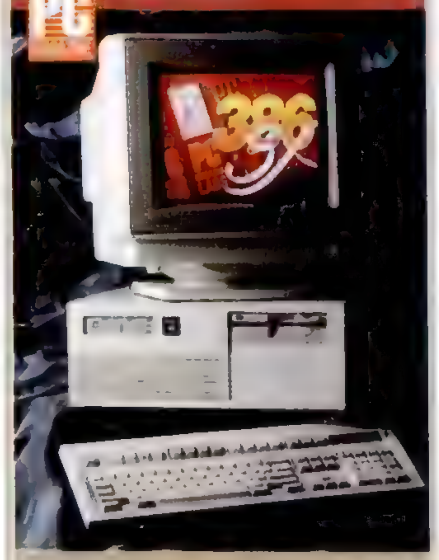
The Ultra's case contains ample room for other components. Two 8-bit and six 16-bit expansion card slots sit inside, with five slots vacant in the tested system. The two 8-bit slots can use only half-length expansion cards, and a short I/O card comes installed in one of the slots. The length limitation in the remaining 8-bit slot seems a small trade-off when you consider what the rest of the case offers. It holds two 3.5-inch-format storage devices mounted horizontally and gives you space for three half-height devices. Only the half-heights can use removable media, but with the increasing capacity of 3.5-inch hard disks you could fill the half-height bays with two floppy disk drives and a tape drive and still have space for two 3.5-inch hard disks. The 200-watt power supply has five power leads for drives, so you can connect all of those devices.

The Ultra 386SX performed well on PC Labs' benchmark tests, turning in above-average scores on floating-point, memory, video, and DOS File Access tests and somewhat slower results on the 80386 Instruction Mix and BIOS Disk Seek tests.

Computer Market Place sells machines directly to end users by mail order only. It provides a one-year parts-and-labor warranty and offers a one-year on-site service contract from Sorbus for $100. If you don't take the on-site contract, you'll still never have to send the system in for service. Computer Market Place makes it a policy to replace defective parts or whole systems by Federal Express if they fail during the warranty period. Even if you add in the cost of the on-site contract, the Ultra 386SX remains price-competitive.

Despite the Ultra 386SX's small-footprint format, it furnishes more than the usual drive expansion space. Computer Market Place also gives you an attractive mix of price and service with the machine. The Ultra 386SX is a good deal.

FACT FILE



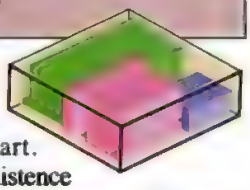
Ultra 386SX
Computer Market Place Inc., 450 Pkwy., #202, Broomall, PA 19008; (800) 545-7397, (215) 359-0750.
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, Hercules monochrome monitor, one parallel and two serial ports, game port, $1,149; with 2MB RAM, 65MB hard disk, VGA monitor, DOS 3.3 or 4.01, $1,789.
In Short: Although the small-footprint Ultra 386SX doesn't come with an on-site service contract, you'll never have to send it in for warranty service. Computer Market Place will ship a new part or if necessary a whole system during the one-year warranty period. The Ultra offers a very good price and performance that rates a little better than average for its class.

CIRCLE 420 ON READER SERVICE CARD

COTÉ COMPUTERS OF ARIZONA INC.

Coté 386 Plus

by Ed Perratore



Coté Computers of Arizona got off to a good running start. Nine weeks in existence as of mid-April, the company had already debuted a 286/12 PC and four 386 models, including the 80386SX-based Coté 386 Plus. This growing company runs three showrooms in the Phoenix area, expects to open two more shortly, and should already be sending mail-order shipments by the time you read this.

Not that Coté's arrival on the scene promises to send every competitor running for cover; our review model revealed some rough edges and middling benchmark test scores. But this small-footprint machine ($1,785 for our standard configuration) already has plenty to offer the low-end 386 market. And if the company's plans come to fruition, Coté Computers of Arizona may be joined by Coté Computers of your home state in the not-too-distant future.

The Coté 386 Plus has a $1,295 base price that includes 1MB RAM, a 28-millisecond 40MB Integrated Drive Electronics (IDE) hard disk from Western Digital, a TEAC 1.2MB floppy disk drive, a Samsung 12-inch monochrome monitor, one parallel and two serial ports, and a game port. DOS 3.3 costs an extra $76. Our $1,603 test configuration also added a 1.44MB floppy disk drive, a Trident 16-bit VGA card, and a VGA multiscanning monitor.

Apparently the company's selection of a lesser-known motherboard from USA-based Deico Electronics and a VLSI chip set from VIA Technology haven't hurt the product's performance. PC Labs' processor benchmark tests ranked the 386 Plus in

386SX-BASED COMPUTERS: SUMMARY OF FEATURES

	Gateway 2000 Inc. Gateway 2000 80386SX	HiQuality Systems Inc. HiQ386SX-16/20	☑ Micro Express Micro Express ME 386SX	Mitsuba Corp. Mitsuba MIT-SXA	National Micro Systems Inc. Flash 386SX-16	Novacor Inc. Novac 386SX-16	Pan United Corp. PC 386/SX Business System
FLOPPY DISK DRIVES							
Type	1.2MB	1.2MB	1.2MB	1.2MB	1.2MB	1.2MB	1.2MB
Manufacturer	TEAC	TEAC	Y. E. Data	Epson	Y. E. Data	TEAC	TEAC
EXPANSION BUS							
Bus speeds (MHz)	8	8	8	8	8	5, 10	8
Expansion slots	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Three 8-bit, five 16-bit	Two 8-bit, six 16-bit	Two 8-bit, six 16-bit	Three 8-bit, five 16-bit	Two 8-bit, six 16-bit
Slots left free after hard/floppy disk drives, video, one parallel and two serial ports are installed	5	5	6	5	6	5	5
Ports originate on mother board	❑	❑	❑	❑	❑	❑	❑
VIDEO							
Display circuitry location	Card	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	8-bit	16-bit
Manufacturer	ATI	Prolink	Ahead Systems	Western Digital	Paradise	Novacor	Video 7
Chip set manufacturer	ATI	Intel	Ahead Systems	Paradise	Paradise	Chips and Technologies	Video 7
KEYBOARD							
Manufacturer	Fujitsu	Key Tronic	Maxi-Switch	Honeywell	Maxi-Switch	Maxi-Switch	Chicony
Number of keys	101	101	101	101	101	101	101
Number of function keys	12	12	12	12	12	12	12
Keyboard cable length (inches)	72	72	60	112	73	60	72
SOFTWARE AVAILABLE							
OS/2	None	1.2	1.2 ($275)	None	None	None	None
Disk caching software	None	None	None	None	None	None	None
Expanded memory manager	None	None	None	LIM EMS 4.0 (included)	None	LIM EMS 4.0 (included)	None
Other	*Microsoft Windows* 3.0	None	SCO Xenix, Version 2.3.2 ($700)	None	None	None	None
MISCELLANEOUS							
Physical features:							
Power supply (watts)	200	230	200	200	200	200	200
Switchable settings	■	■	■	■	■	■	■
Number of device connectors	4	4	4	4	4	4	4
Keyboard lock	Front	Front	Front	None	Front	Front	Front
Case lock	Front	None	Front	Front	None	None	Front
Power-on switch	Side	Side	Front	Side	Side	Front	Side
Reset switch	Front	Front	Front	Front	Front	Front	Front
Warranty	1 year	1 year	15 months	1 year	1 year	1 year	1 year
Service	Express parts swap; on-site service	Return to manufacturer	Express parts swap, or return to manufacturer	Return to dealer; on-site optional	Return to manufacturer	Return to manufacturer	Return to depot, dealer, or manufacturer
FCC certification	B	B (pending)	B	B	B	A	B
Distributed through dealers or direct	Direct	Both	Direct	Dealers	Direct	Direct	Dealers

☑—Editor's Choice ■—Yes ❑—No

PC Craft Inc. PCC 2260/16SX	Precision Systems Group Inc. PSG 8038663X/16	Tenex Computer Express Tenex 386SX HD VGA System	Treasure Chest Treasure Chest TC 386SX
1.2MB TEAC	1.2MB TEAC	1.2MB Chinon	1.2MB Mitsumi
8 Two 8-bit, six 16-bit 5	8, 10, 12 Three 8-bit, five 16-bit 5	8 Two 8-bit, six 16-bit 5	8 Two 8-bit, six 16-bit 5
❑	❑	❑	❑
Card 16-bit PC Craft (Western Digital) Paradise	Card 16-bit Everex Everex	Card 16-bit Everex Cirrus Logic	Card 16-bit Chicony Trident
Maxi-Switch 101 12 72	Key Tronic 101 12 72	Chicony 101 12 84	Chicony 101 12 60
None None *386Max* ($20) SCO Unix 386 ($695)	None None None None	None None LIM EMS 4.0 (included) None	None None None None
200 ■ 4	150 ■ 5	200 ■ 4	200 ■ 4
Front Front Back Front	Front None Front Front	Front None Side Front	Front Front Side Front
1 year 4 months on-site, then return to manufacturer	2 years Return to dealer	2 years Return to manufacturer; on-site optional	1 year Return to manufacturer; on-site optional
B Dealers	A Dealers	B Direct	B Direct

ENDS

the upper third among the machines reviewed.

Our tested model used the required 386SX-16 chip, but a Deico representative notes that the same board will also run a 20-MHz SX chip once Coté begins to sell this configuration. Another alternative, which you can select by changing a jumper, is to run the 16-MHz chip at 20 MHz (the system's .3 wait states remains the same). Coté discourages this practice, however, because of the usual dangers of overheating. For that matter, it also tends to overheat the machine's 18-month warranty.

SIMM-packaged, 80-nanosecond DRAM runs in bank-interleaved page mode; you can fit up to 8MB of memory on the motherboard using 1-megabit chips. The 386 Plus score was just average on the Conventional Memory test, but here most of the scores are separated only by a few hundredths of a second—hardly representing delays that will send you to the coffee machine.

Coté 386 Plus
Coté Computers of Arizona Inc., 1817 S. Home, #6, Mesa, AZ 85204; (800) 562-4084, (602) 892-8737.
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, monochrome monitor, one parallel and two serial ports, game port, $1,295; with 1 2MB 5.25-inch and 1.44MB 3.5-inch floppy disk drives, VGA monitor, DOS 3.3, $1,603; with 2MB RAM, 60MB hard disk, single floppy disk drive, $1,785.
In Short: Though no racehorse, the Coté 386 Plus has come out of the gate with some smart design and a considerate on-site support policy topped by a generous RAM upgrade policy. This new company may not require much time to get fully up to speed.

CIRCLE 421 ON READER SERVICE CARD

PC LABS

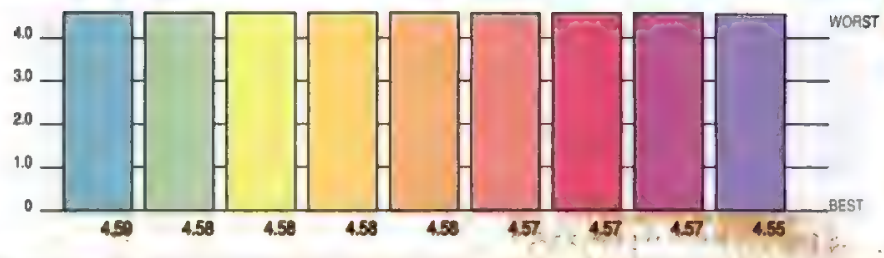
BENCHMARK TESTS: 386SX-BASED PCs

No machines stood out across the board. Compared with our reference Compaq machine, the Gateway 2000 80386SX and Treasure Chest TC 386SX both gave sterling performances on the 80386 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests. But it was the BroadAx BSI 386SX that garnered top honors, with first-place finishes on the three processor and memory tests.

PROCESSOR AND MEMORY BENCHMARK TESTS

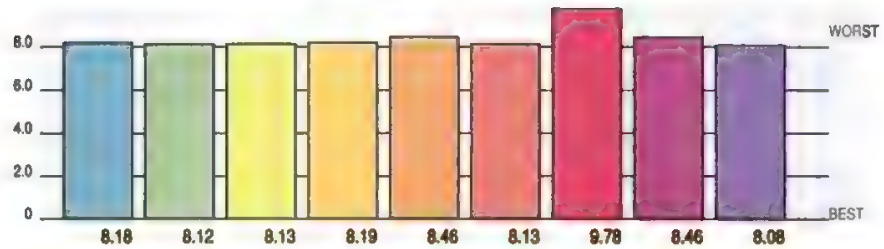
80386 Instruction Mix

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



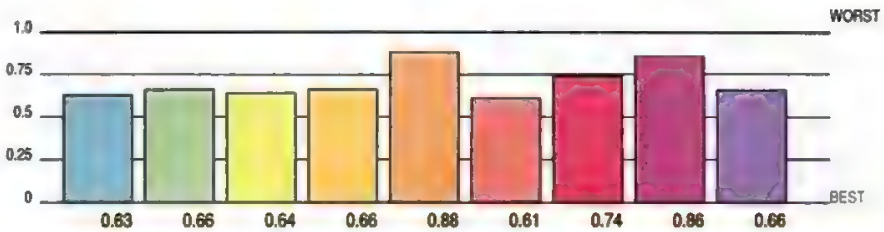
Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

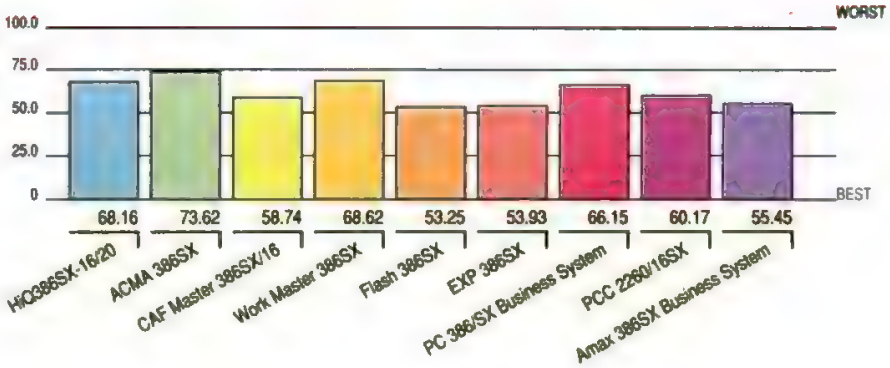
The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

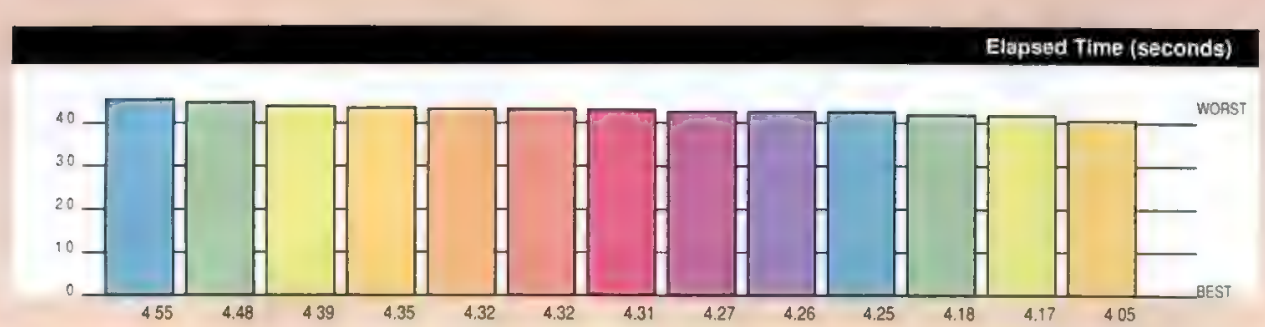


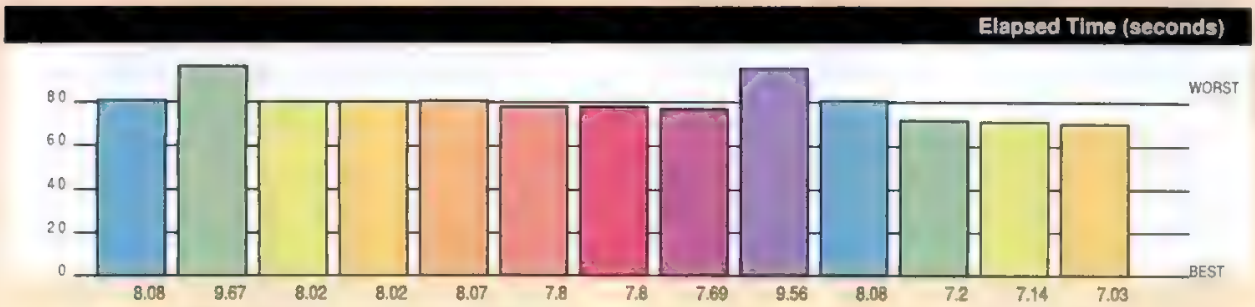
DISK BENCHMARK TESTS

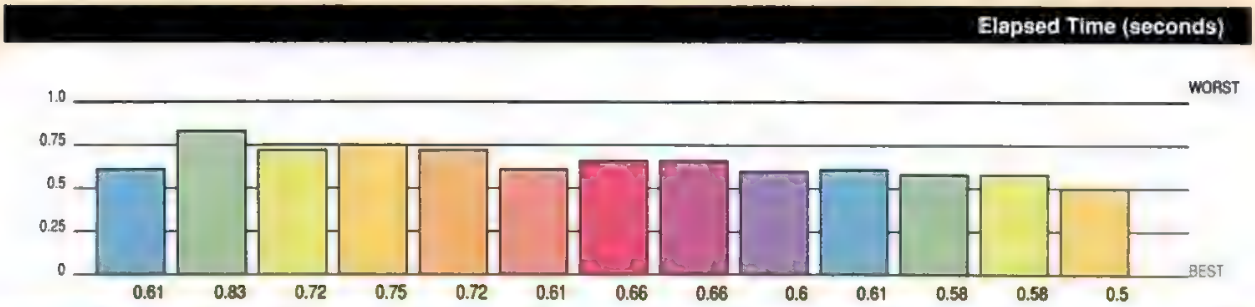
DOS File Access (Small Records)

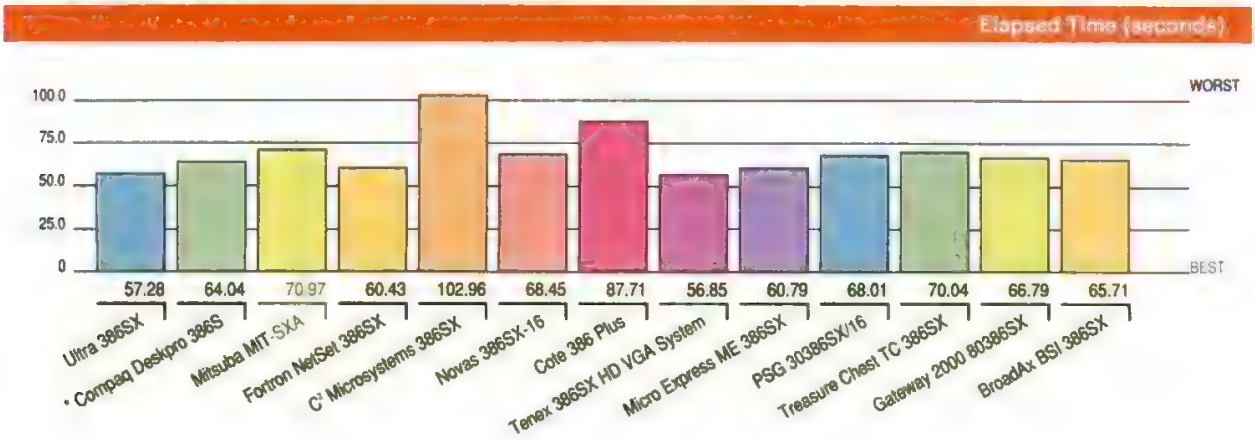
The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.











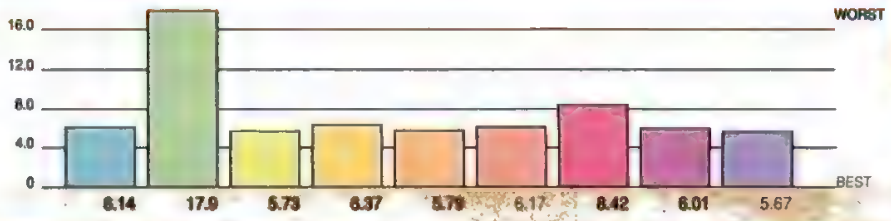
*Reported for comparison.

CONTINUES

BENCHMARK TESTS: 386SX-BASED PCs

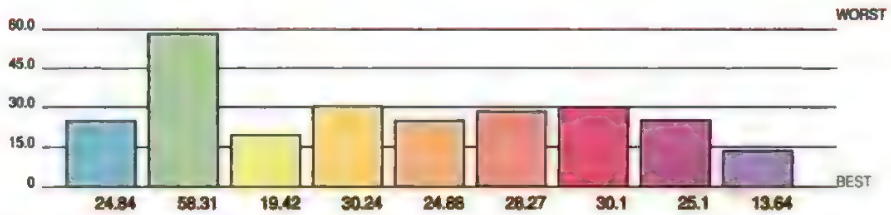
DOS File Access (Large Records)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



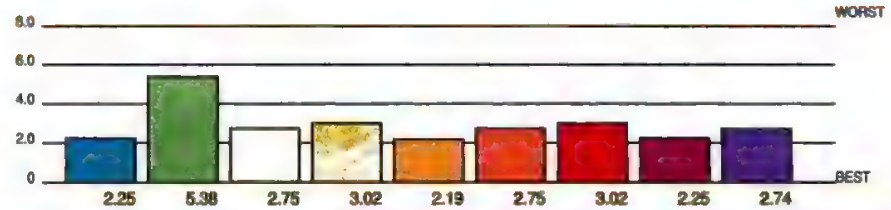
BIOS Disk Seek

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.



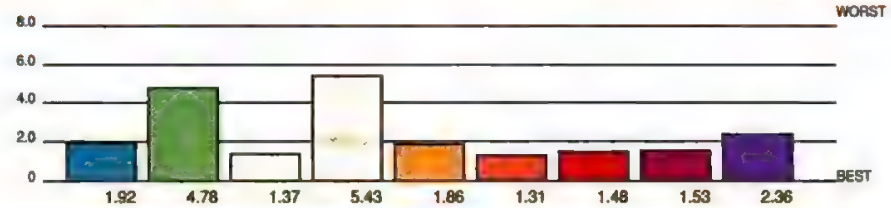
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



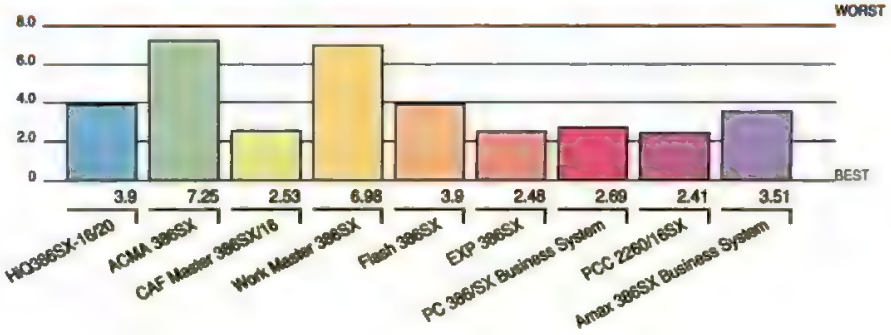
Video BIOS Routine Without Scrolling

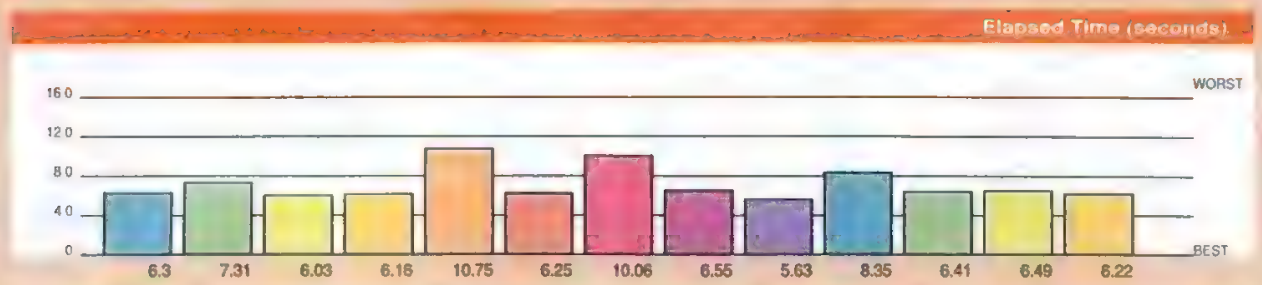
The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

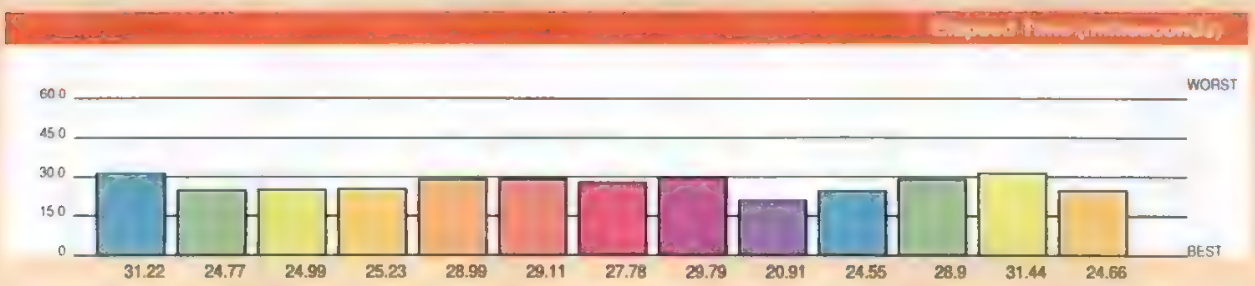


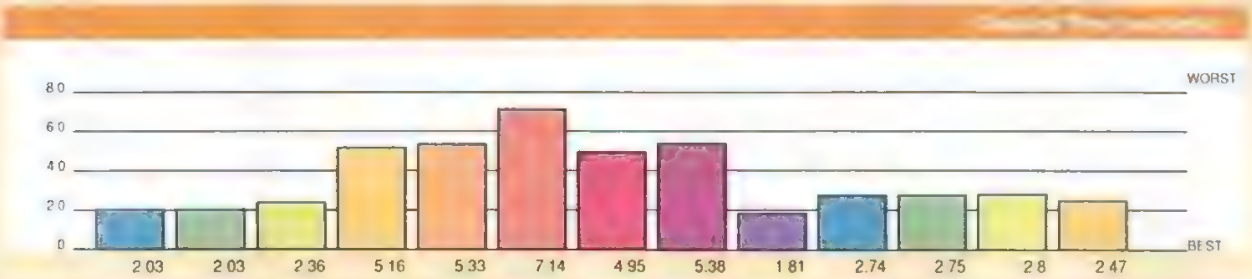
Video BIOS Routine with Scrolling

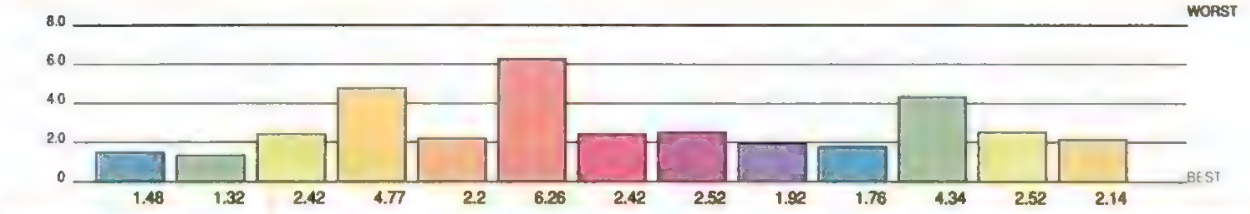
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

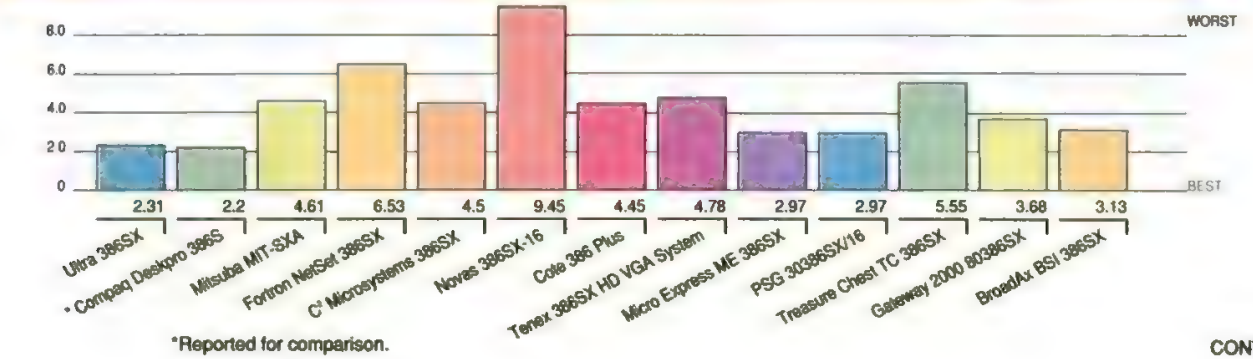












*Reported for comparison.

CONTINUES

Now that everyone agrees how a computer should work,

Judging by what you see on magazine covers these days, the world now wants what the Macintosh® computer has always had. And, suddenly, the idea that a personal computer should be easy for people to use has been embraced by virtually every major player.

Well, since "Mac-like" is the promise on every lip, this might be a good time to point out just what a Mac® is like.

What makes a Macintosh a Macintosh is more than cheerful icons, a mouse, pull-down menus and other surface manifestations. Because a Macintosh is a Macintosh from the inside out. Conceived from the chip up to work intuitively and visually.

Because it's truly consistent, the entire family of Macintosh personal computers all run the same software with identical point-and-click simplicity.

Because it's a true system, Macintosh printers and other peripherals all connect together quickly and logically. Just plug them in and turn them on.

Because we engineer both the hardware and its operating software, Macintosh runs with the smooth speed and precision you'd expect from any perfectly integrated design.

And because Macintosh isn't a "graphical" shell grafted on top of a character-based system, it doesn't expend lots of expensive computing power trying to do something it wasn't designed for.

Which is why, for less than it usually costs to buy the software and the high-end hardware needed for a Mac look-alike, you can have the true article.

Instead of making do with a handful of graphicized programs, you can choose from the thousands of highly

**The figures don't come from us. They're from a 1990 study conducted by Diagnostic Research, Inc., among Fortune 1000 MIS managers and business computer users. Call and we'll send you a copy.*
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try the only one that actually works that way.

innovative business applications developed specifically for Macintosh over the last seven years. And instead of patiently following the long path from yesterday's MS-DOS to Windows in the interim and to OS/2 in the someday, you can make one simple step to Macintosh.

The benefits of that step, according to a new independent study* by Diagnostic Research, Inc., are considerable.

It seems when people have a machine that works like people do, they get more done with it. Information managers in the study gave Macintosh productivity ratings that were 32% higher than for PCs running Windows. Which in practical terms is like getting almost two extra days per week, or 17 more weeks out of a year.

Meanwhile, what would you sacrifice by making the change to Macintosh?

Not your PC files. Every Macintosh equipped with an Apple® SuperDrive™ disk drive moves information easily between a Macintosh and an MS-DOS or OS/2 PC on industry-standard, 3½-inch floppy disks.

And not your PC programs, either. With products like Mac286 a Macintosh can run virtually any DOS application. We invite you to call 800-538-9696, ext. 875, for the names of your nearest authorized Apple resellers.

Then come in and see what inspired the monumental changes you've been reading about.

After all, now that everybody else is trying to sell you a Macintosh, maybe you should buy one.

The power to be your best.™

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CIRCLE 251 ON READER SERVICE CARD

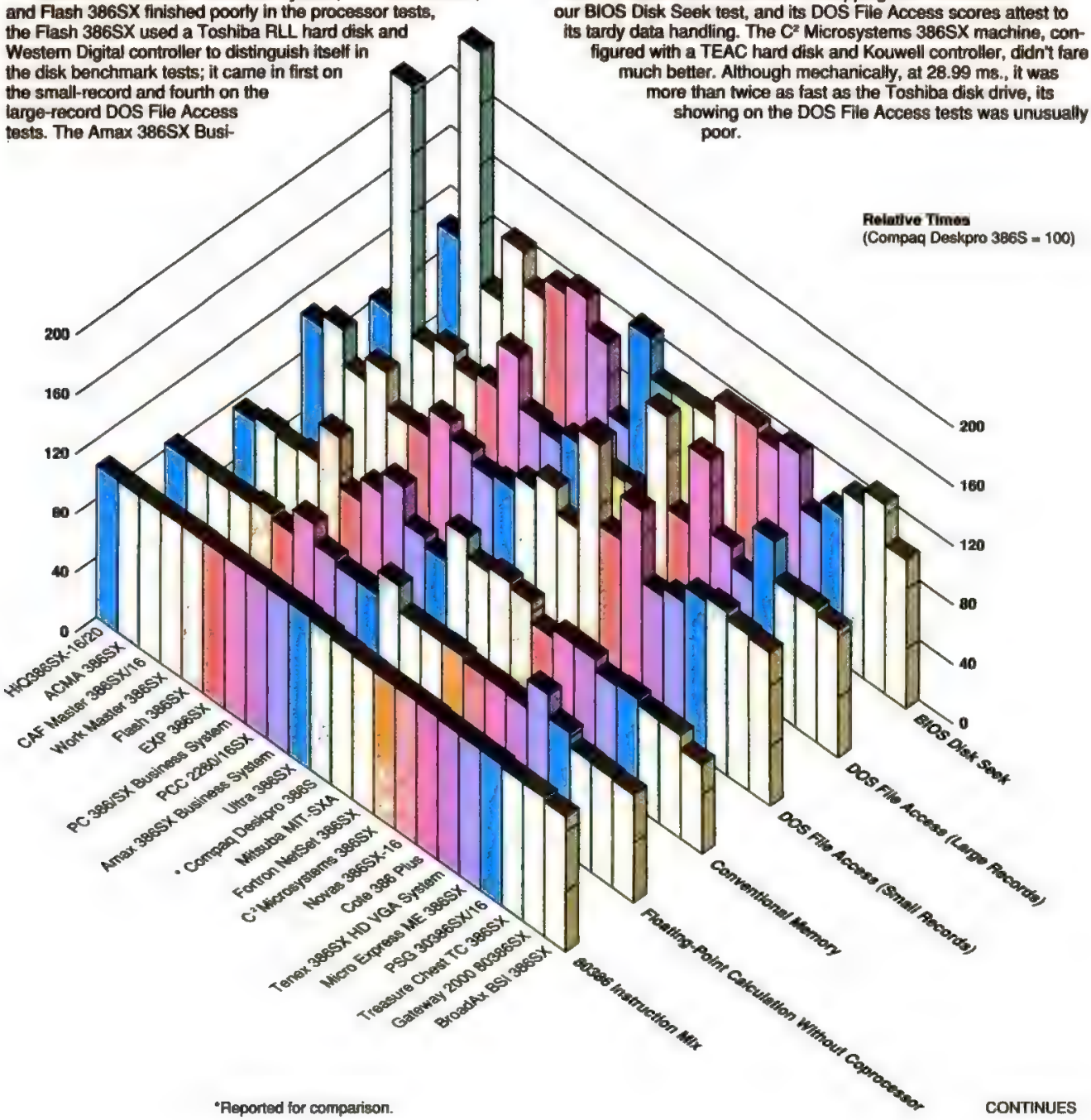
PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

PC Labs tested 21 computers in the 16-MHz 80386SX class and normalized them against the Compaq Deskpro 386S, whose scores we are reporting for comparison.

The Gateway 2000 80386SX and Treasure Chest TC 386SX both gave sterling performances in the 80386 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests, but it was the BroadAx BSI 386SX that garnered top honors, with first-place finishes in the three processor and memory tests.

While the PC 386/SX Business System, PCC 2260/16SX, and Flash 386SX finished poorly in the processor tests, the Flash 386SX used a Toshiba RLL hard disk and Western Digital controller to distinguish itself in the disk benchmark tests; it came in first on the small-record and fourth on the large-record DOS File Access tests. The Amax 386SX Business System, the CAF Master 386SX/16, and the Micro Express ME 386SX had impressive results on the disk tests as well, with the Amax proving that there's no substitute for a mechanically fast disk drive. Its CDC hard disk ran the BIOS Disk Seek test in 13.64 milliseconds, making it the fastest product in terms of track-to-track access time; it was also the top performer on the large-record DOS File Access test.

The disk test results for the ACMA 386SX prove just the opposite. Its Toshiba hard disk took a whopping 58.31 milliseconds on our BIOS Disk Seek test, and its DOS File Access scores attest to its tardy data handling. The C² Microsystems 386SX machine, configured with a TEAC hard disk and Kouwell controller, didn't fare much better. Although mechanically, at 28.99 ms., it was more than twice as fast as the Toshiba disk drive, its showing on the DOS File Access tests was unusually poor.



*Reported for comparison.

CONTINUES

Buy IBM. Add CORE performance: 5-year warranty. Save $17,000.

Recently PC Magazine and **Price Waterhouse** completed a long-term test series to see how LANs, UNIX based systems and minicomputers each performed running the same RealWorld™ set of accounting operations. Here's what they had to say:

"In this suite of multiuser accounting tests, the clear overall winner is the LAN, specifically (and surprisingly) the LAN powered by the 20-MHz IBM PS/2 Model 80 with its 32-bit Novell adapter and ultrafast Core ESDI hard disk."

The $17,000 bungle.

All other components of the LAN being identical, one *could* replace the venerable Model 80 (20MHz 386) Micro-channel & the CORE mass storage combo for a "faster" Compaq System Pro running a single 386/25.

Performance would *drop about 20%*, and the cost would be $17,000 higher. Armed with this knowledge and the intelligence of sand, one could hardly recommend such a swap.

No drive is an island.

It was not simply the CORE drive that made the performance improvement. True, the drive is fast – knowing this, IBM chose our SCSI version to announce & demo their long-awaited SCSI Host Adapter.

The proprietary CORE controller also used in the accounting test is a true bus master, designed specifically to dramatically enhance the superior I/O capabilities *already* built into Micro Channel machines. And these I/O benefits extend to non-accounting applications like CAD, DTP, etc.

IBM Business Partner

"...the special Core hard disk and controller helped the Model 80 [386/20Mhz] to compete well with 25 MHz 486 and 33MHz 386 upstarts." —F. Derfler and K. Thompson PC MAGAZINE May 29, 1990

For once, more is more.

Considering LANs with 10 to 100+ users, the team of IBM's PS/2s and the CORE drive/controller mass storage solution is the prudent as well as performance choice. Here's why:

The *"mini-killer"* drive & controller used in the PW/PC Mag test was a CORE 310MB HC Series drive rated at 10MHz. Its companion CORE bus master controller could transfer data at up to 15MHz.

"Our recommended combination is the Core HC Series of hard disk drives and 15MHz controllers... Core provides a three-year full replacement warranty so you know they believe in their products." —Frank Derfler, PC MAGAZINE

Nice as that is, we decided to push the envelope a bit faster. Actually, about 5,000,000 bits faster.

So in addition to our 10 and 15MHz drives we now proudly offer a new series rated at a *screaming* **20MHz**.

That means data throughput as high as 2,000KB sec.

They're available in 310, 650 and 1,000MB with matching high-performance controllers.

And in SCSI as well as ESDI.

For AT-bus as well as Micro Channel.

150,000 hours MTBF.

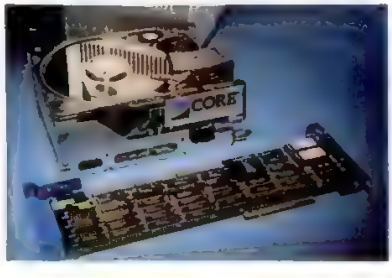
And the industry's first **5-year warranty.**

Yep, 5-years, full-replacement.

And IBM's on-site service is available.

Contact your local dealer.

Or call CORE. After all, *IBM did.*



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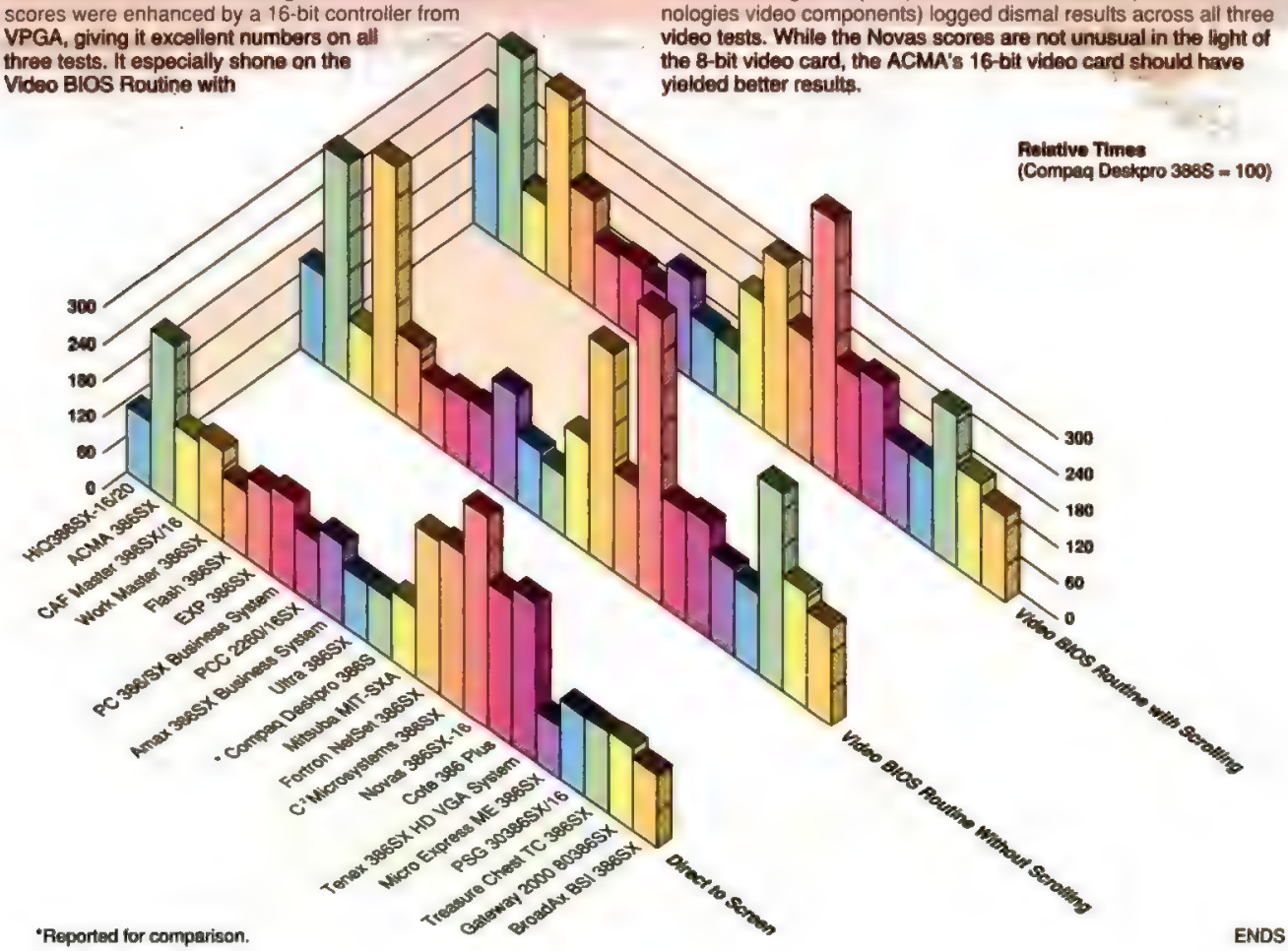
CIRCLE 198 ON READER SERVICE CARD

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The Micro Express ME 386SX excelled on the Direct to Screen test, surpassing the NCR PC386sx (*PC Magazine*, January 30, 1990) by almost 9 percent, while the EXP 386SX managed to best the Compaq Deskpro 386S—our reference machine—on the Video BIOS Routine Without Scrolling test. The Ultra 386SX's video scores were enhanced by a 16-bit controller from VPGA, giving it excellent numbers on all three tests. It especially shone on the Video BIOS Routine with Scrolling test, where it placed first among the machines we reviewed, although it still was slower than the Compaq Deskpro 386S.

Both the Novas 386SX-16 (with a 8-bit Novacor card and Chips and Technologies chip set) and the ACMA 386SX (with OAK Technologies video components) logged dismal results across all three video tests. While the Novas scores are not unusual in the light of the 8-bit video card, the ACMA's 16-bit video card should have yielded better results.



*Reported for comparison.

ENDS

Unfortunately, the hard disk broke no speed records on our hard disk benchmark tests, where the differences are more substantial. The DOS File Access tests left the 386 Plus near the bottom of the heap. The Trident video card fell short on our video benchmark tests as well.

One compensation is the unit's conservation of expansion slots. Its 3.5-inch floppy disk drive slides into a vertical slot beside the three half-height bays. The I/O ports are integrated into the motherboard for greater speed; this design also frees the one 8-bit slot. And thanks to the IDE floppy/hard disk controller, which requires a motherboard connection but no slot, you have five 16-bit slots left after the video adapter takes its slot.

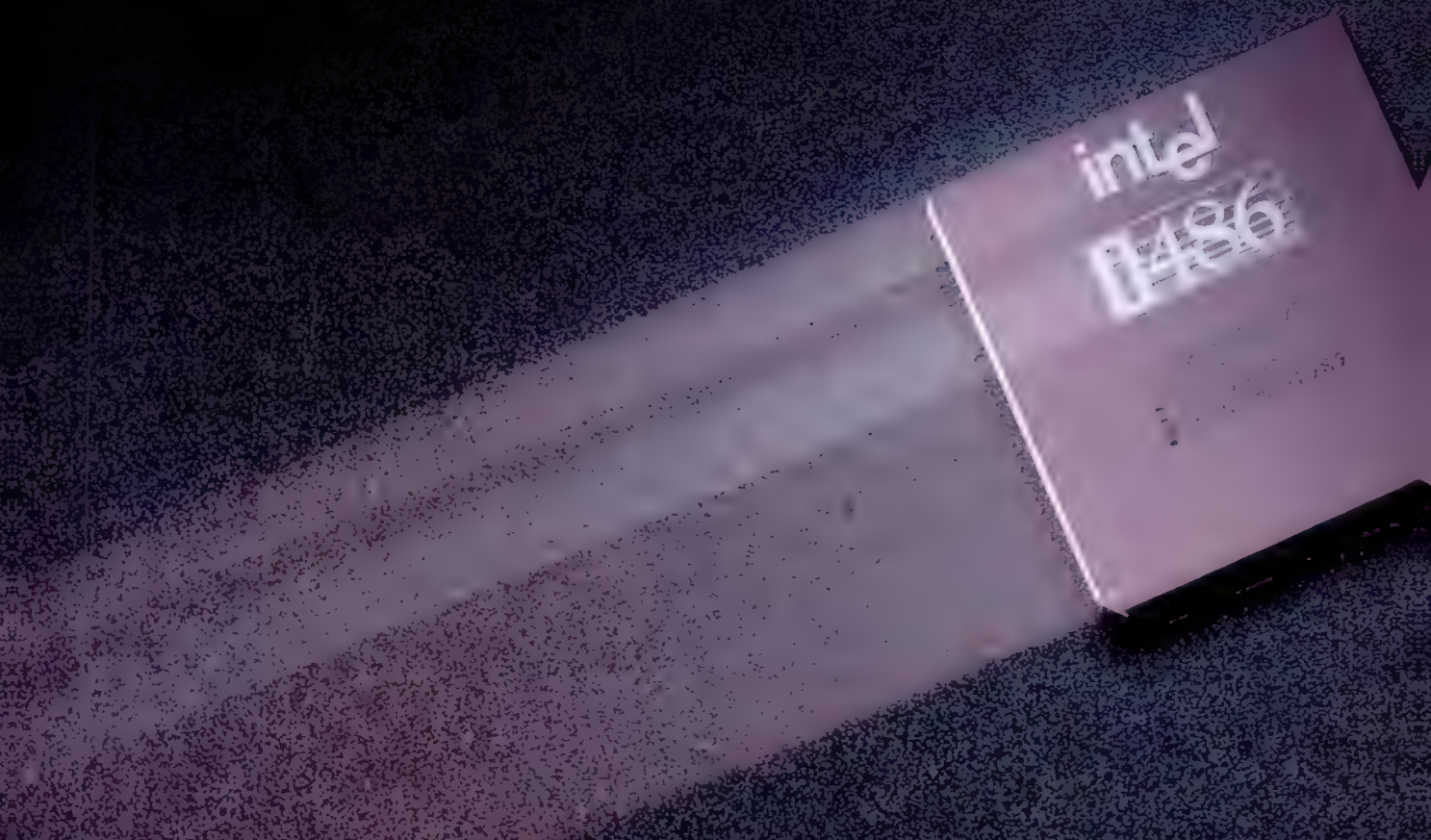
Coté Computers operates five retail stores in the Phoenix region, with plans to expand to the San Francisco Bay area and several other states. In addition, the company has wasted no time in backing up its PC product line with on-site service included in the price.

The company's RAM upgrade policy is a rarity among PC vendors. If a RAM upgrade requires any replacement of your present 256-kilobit chips with 1-megabit chips, the company offers a 100 percent credit on the RAM chips you trade in, no matter how long you've owned the machine. Thus, for an upgrade from 1MB of 256Kb chips to the full 8MB, you'd pay Coté only for the 7MB upgrade.

Shortly before press time the 386 Plus earned its FCC Class B certification, but no such sticker adorned the rear of our tested unit. We learned why: our review model sported some crude copper plating behind the front of the case. The company assures us that it is now using FCC-recommended copper-filled paint to contain emissions.

The Coté 386 Plus has made some wor-

'486 EISA



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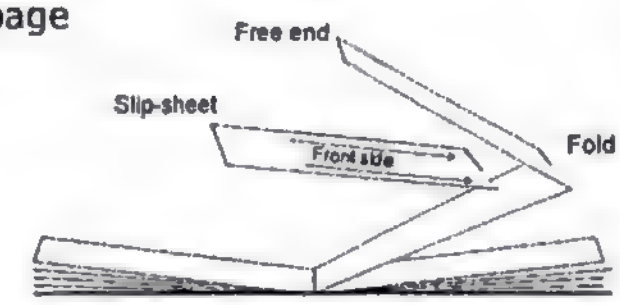

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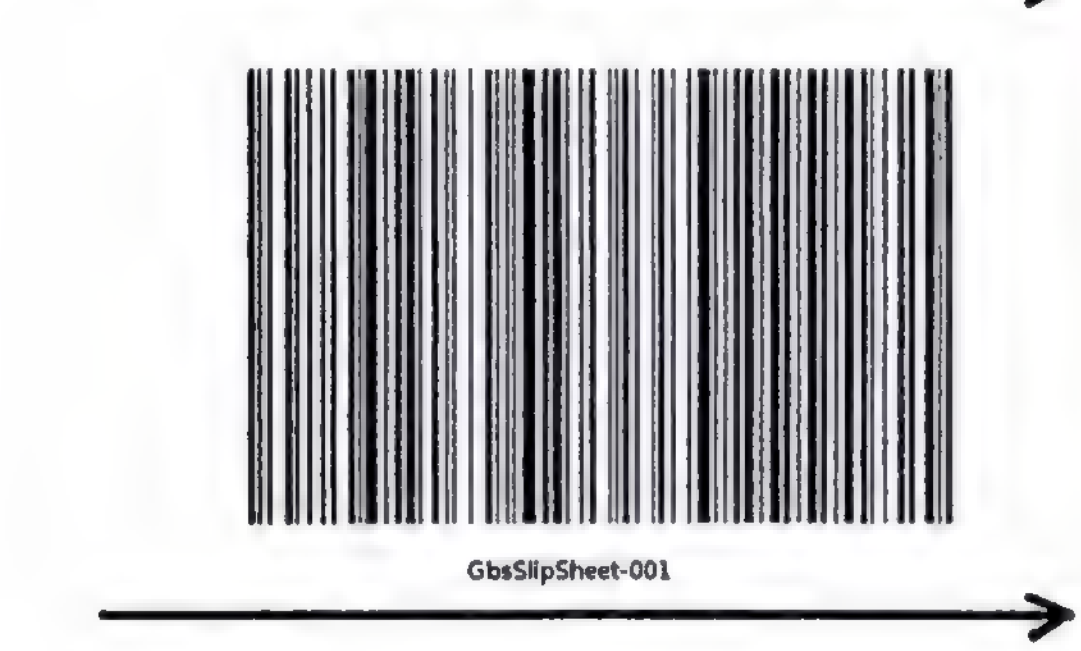

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Back

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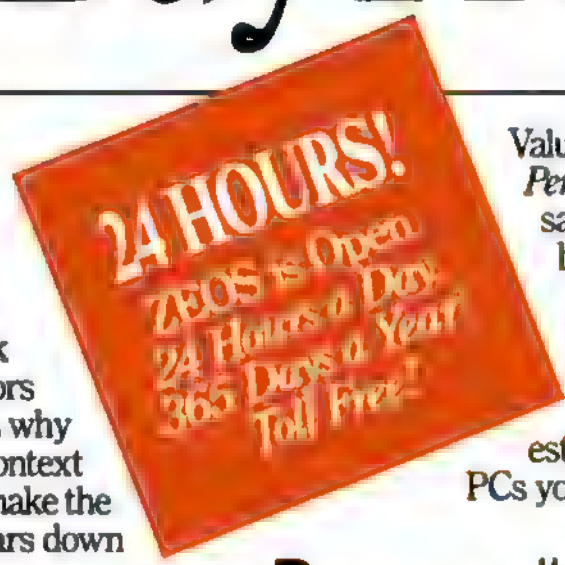

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

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Reason #5

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Reason #8

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In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

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ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Requested Line of Credit $ _____

Your Name _____ First Initial Last Date of Birth _____ Mo Day Yr.

Present Address _____ Street Apt. # City State Zip

Social Security Number _____ ( ) Home Phone

Date of Residence _____ Month Year Monthly Payment $ _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

Dates of Residence _____ From To

Your Employer _____
(If self-employed, see rear panel.)

Date of Employment _____ Mo. Yr. Position _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

Previous Employer _____ Address _____

Dates of Employment _____ From To

Other Income _____ I have received since (Date) _____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation

Monthly Income _____ Gross $ Net $

Name and Address of Nearest Relative Not Living With You _____

Relationship _____

b. Credit Information

Include joint information, if joint account requested

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Loan Reference _____ Bank Name Address

Payment _____ Balance _____

Bank Card Reference _____ Bank Name Address

☐ VISA ☐ Mastercard Payment _____ Balance _____

(please check appropriate box):

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☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history.* This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card Reference _____ Bank Name Address

Payment _____ Balance _____

Other Credit References _____ Payment _____ Balance _____

Account No _____ Expires _____

Driver's License No. _____ State _____ Expires _____

c. Joint Personal Information

Joint Name _____ First Initial Last

Date of Birth _____ Mo. Day Yr. Social Security Number _____

Address _____ Street Apt #

City State Zip

Date of Residence _____ Mo. Yr. Home Phone ( )

Employer _____

Date of Employment _____ Mo Yr Position _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

d. Self-Employed Information

Complete this section only if you are self employed.

Business Name _____

Business Address _____

☐ Proprietorship ☐ Corporation ☐ Partnership Business Phone ( )

Description of Business _____

Your Position _____ In Business Since _____

Your annual income from business _____ Business' annual income _____ (gross) (net)

You must provide at least one of the following:

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( ) Telephone Personal Banker's Name

2. Accountant's Name _____

( ) Telephone

3. Financial statement on business attached.

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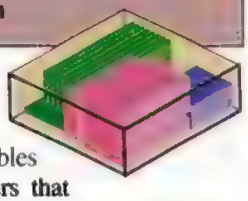
thy strides, and the company certainly bears watching. Processor speed aside, the 386 Plus is no racehorse. But in its short time in the marketplace, Coté has shown that it thinks about what users look for in a 386SX machine. At $1,785, the 386 Plus already has appeal as a suitable 386SX choice.

C² MICROSYSTEMS INC.

C² Microsystems 386SX

by Bruce Brown



C² Microsystems, better known as "C Squared," assembles standard computers that it then resells through dealers and distributors, not directly to end users. C²'s 386SX machine scores rather low on PC Labs' benchmark tests, and its above-average list price derives from the dealer sales channel, though you can probably use the prices mentioned in the review as starting points from which to bargain with most vendors.

The C² 386SX comes in a small-footprint case measuring 7 by 15 by 16.25 inches. It retails for $2,125 and contains 2MB RAM, 66MB hard disk, TEAC 1.2MB floppy disk drive, 16-bit Shogun VGA display adapter with Gemini chip set, Amazing color VGA monitor, one parallel and two serial ports, Chicony keyboard, and DOS 3.3. Our tested machine didn't include a coprocessor but came configured with a smaller 42MB Toshiba hard disk and 4MB RAM, all at a list price of $2,220.

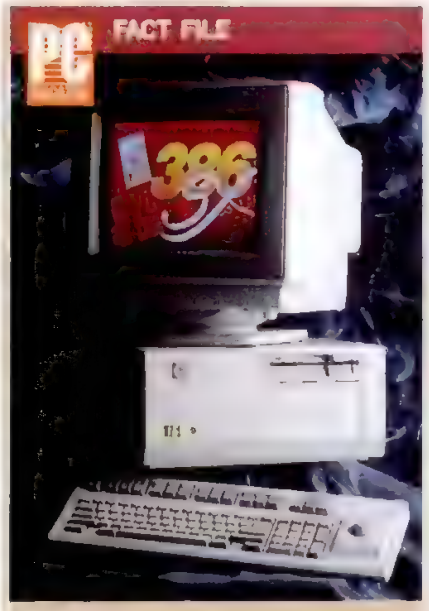
MBI, a less familiar name than we usually see, manufactures the C² 386SX's motherboard, which employs the standard Chips and Technologies 386SX chip set and AMI ROM BIOS chips. If you prefer Phoenix or Award ROMs, either kind is available on request for the same price. The zero-wait-state motherboard (one wait state is selectable via jumper) uses the standard page-mode memory interleaving scheme and holds up to 8MB total RAM using 100-nanosecond DIP chips. The case of the C² 386SX holds one 3.5-inch and three half-height drives, feeding electricity to each device by way of a 200-watt power supply.

The keyboard, which boasts a convenient three-button trackball, has two cables: one the standard keyboard cable, the other a serial cable with a 9-pin mini–D shell connector that plugs into the system's 9-bit serial port to transmit I/O signals for the trackball. Mouse driver software for the trackball is included. The trackball/keyboard combination, an oddity in years past, is growing more common as graphical interface software becomes more widespread. If you want to save space on your desk and you find a trackball an acceptable alternative to a mouse, this solution makes sense. Of course, if either the keyboard or the trackball fails, you have to replace both at the same time, buying either separate components or another combination unit. Nevertheless, the convenience of the input combination is enough to persuade many users to want one on their desks.

In our testing, the C² 386SX generally scored below average within this group of machines. Processor tests seemed to be the C²'s strong point; its weakest scores occurred on the DOS File Access tests for both small and large records.

C² includes a one-year warranty on parts and labor for its machine. On-site service doesn't come standard but is available as a dealer option. If you require service during the warranty period, you can either return the equipment to your dealer or send it to the manufacturer, in which case you pay for one-way shipping.

The C² Microsystems 386SX is a standard machine with acceptable expansion capacity. It functions on the slower side of average, but if you can negotiate a good price from a dealer, you may be pleased with the C² 386SX.



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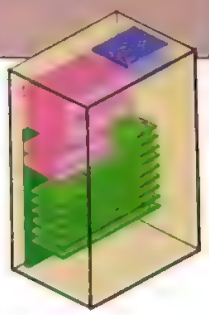
C² Microsystems Inc., 1205 Fulton Place, Fremont, CA 94539; (415) 683-8888.
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, $1,695; with 2MB RAM, 66MB hard disk, VGA monitor, 3.3, $2,125; with 4MB RAM, 42MB hard disk, $2,220.
In Short: The C² 386SX machine is a small-footprint machine sold through dealers and distributors only. The price may seem a bit high for the machine's below-average performance, but discounts are usually available through dealers.

CIRCLE 422 ON READER SERVICE CARD

DYNA MICRO INC.

Work Master 386SX

by Rink Murray



Buying your SX computer from Dyna Micro is like assembling a designer clothing ensemble at a shopping mall. You plunk down $1,900 for a Work Master 386SX and you get to choose how you want to fill a minitower case with a wardrobe of brand-name computer parts.

The Work Master's minitower measures 13 by 7 by 16 inches and looks suitable either sitting on the desktop or standing on the floor. It contains enough room for two half-height 5.25-inch disk drives, two one-third-height 3.5-inch disk drives, and a 200-watt power supply. The case lock, power switch, turbo and reset buttons, and LED lights sit on the front panel within easy reach.

Dyna Micro will configure your system just about any way you wish. For bargain-hungry shoppers, the company will assemble your machine with used parts if they're available. The used parts come with a 90-day warranty; new components ship with a full one-year warranty.

What do all the options mean to you? You can generally get a machine that performs well, configured with the parts you request, for a reasonable price. Our test system arrived with a 65MB RLL Seagate ST277R hard disk bundled with On-Track's *Disk Manager* software and a

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Work Master 386SX
Dyna Micro Inc., 30 W. Montague Expwy., San Jose, CA 95134; (408) 943-0100.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, $928, with 2MB RAM, 65MB hard disk, VGA monitor, DOS 3.3, $1,900.
In Short: The Work Master 386SX has no major flaws, although it did perform slowly on several benchmark tests. You get a low price tag and the chance to configure the system your way, and you can lower the price tag further by ordering used parts.

CIRCLE 423 ON READER SERVICE CARD

TEAC 1.2MB floppy disk drive. Unfortunately, the latter lacked a spring to eject the disk when we opened the drive door.

The Work Master performed passably on our benchmark tests, with scores that were usually not far below the middle of the range. The most serious handicaps appeared in the BIOS Disk Seek and Video BIOS Routine tests, where the Work Master finished close to last place.

The Work Master's VGA monitor consists of an analog, tilt-and-swivel ADI-3114. The system's keyboard, an Enhanced-style Mtek, has the clicky feel generally associated with IBM keyboards.

Inside the machine, the Fora motherboard is a no-frills component with just enough space for Intel's 16-MHz 80386SX processor, two 8-bit and six 16-bit slots, a slot for an 80387-SX math coprocessor, and RAM. That's it. Anything else you want to add to the system will take up a slot.

In our tested unit, a Data Technology floppy/hard disk controller occupied one 16-bit slot, while an Orchid ProDesigner VGA adapter inhabited another. If you have a Work Master and want to add parallel and serial ports, be ready to part with $37 and an 8-bit slot. If you need more RAM, there goes your other 8-bit slot. This still leaves you with four free slots, which will be plenty of expansion for most users.

But there's a problem: the position of the drive bays prevents you from installing any full-length cards in the first three slots. In our tested unit, therefore, the full-length floppy/hard disk controller sat a full four slots away from the disks and couldn't get any closer. Ribbons running from the disk drives to the card had to snake around any intermediate cards. The entire crowded experience was bothersome, to say the least.

Dyna Micro is aware of this problem, which it claims is unique to the 65MB hard disk we requested (the Seagate ST277R RLL). This is the only disk drive Dyna supplies with the approximately 60MB capacity needed for our standard configuration. At the time of shipping, all RLL drives required a full-length adapter card.

> It's relatively easy for a small PC manufacturer to buy parts from well-known component suppliers and build machines according to a standard recipe.

Dyna salespeople suggest buying an ESDI drive since it requires only a two-thirds-length adapter card.

System documentation is another problem and often ends up a mess. In place of one indexed user manual, there is a separate pamphlet for each part. If you ever need to switch a jumper, you have to roll up your sleeves and start searching your desk for the correct manual. Fortunately, if you don't want to be bothered, Dyna provides toll-free technical support.

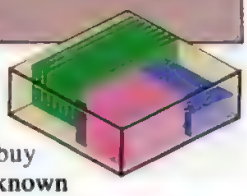
In keeping with the compactness of the system, all components on the Fora motherboard are easily accessible. Our tested unit shipped with 2MB of 100-nanosecond 256-kilobit SIMM chips, expandable to 8MB on the motherboard. Memory uses page-mode interleaving to achieve zero-wait-state performance, and you can select system or video ROM shadowing to increase performance further.

The Work Master 386SX isn't the flashiest SX machine around, nor the most innovative. And it's not quite the cheapest. But if you want a machine put together your way, Dyna Micro provides a frugal option worth considering.

EXPRESS MICRO MART INC.

EXP 386SX

by Ed Perratore

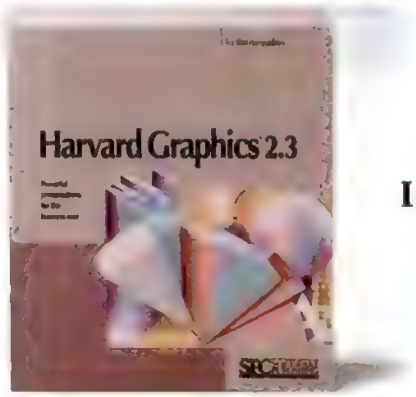


These days, it's relatively easy for a small PC manufacturer to buy parts from well-known component suppliers and then build machines according to a more-or-less standard recipe. Express Micro Mart, a three-year-old seller of mail-order PCs, has accomplished that much. It has followed the recipe and slapped on a fair price. It now needs to add another ingredient, consistent performance, before it can overcome the average user's tendency to stick with more-familiar low-cost models from the likes of Gateway, Dell, and other mail-order competitors.

We tested the EXP 386SX in our standard configuration ($1,818), which included 2MB of SIMM-packaged RAM, a 66MB Mitsubishi hard disk with a Western Digital controller, a 1.2MB TEAC floppy disk drive, super VGA video, and DOS 3.3. In fact, for $1,089 you can get a bare-bones system with 512K RAM, a 30MB Seagate hard disk, the TEAC floppy disk drive, and Hercules monochrome video.

During our testing, the EXP 386SX made a few local stops on PC Labs' processor tests and delayed awhile. The Intel chip set on the machine's Superwave Electronic Co. motherboard left the unit ranked in the lower half of machines on the Floating-Point Calculation test, even when set via a jumper to zero wait states.

If you plan to expand the system's memory after you purchase it, remember that like some of the other machines in this review, it requires you to replace your 256-kilobit chips with 1-megabit chips before expanding the machine to the motherboard's full 8MB capacity. The $89-per-megabyte upgrade price seems competitive, but to go beyond 2MB, you'll be



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starting from scratch. If you think you will want to expand to at least 4MB, ask for 1-megabit chips when you order the machine. Express Micro Mart's board requires you to fill either half or all of the slots, so if you order the machine with either 1MB or 2MB, you normally get 256-kilobit chips. If you order it with 4MB or 8MB, you get 1-megabit chips.

Are these reasons enough to skip on to another machine? Not quite, for the EXP 386SX had a few surprises in store. For one thing, the RLL-encoded, 23-millisecond hard disk ranked among the upper half on PC Labs' DOS File Access tests, whizzing to second place on the small-record test. It ranked in the upper quarter on the Conventional Memory test. Video performance excelled, too; on taking a closer look, we realized why.

During testing, PC Labs ordinarily disables any shadow RAM the system uses; in the EXP 386SX, most of the shadow enabling or disabling can be done in the American Megatrends ROM setup. But the Sefco super VGA adapter, it turned out, performs some video shadowing of its own. Express Micro Mart claims that shadowing on the adapter actually works faster than the video shadowing performed by the motherboard.

What does this capability mean for users who buy the unit with the Sefco adapter? Good news and bad, but mostly good. If you wish to disable all shadowing—on both the video board and the motherboard—to reclaim the full amount of RAM, you have a problem. The system refuses to boot with the video board's shadowing turned off, whether or not any of the motherboard's shadowing is enabled. And if both the video board's and motherboard's video shadowing are enabled, the system again will not boot because both are necessarily addressing the same area of RAM simultaneously.

With the video board's shadowing on and the motherboard's off, however, you have the best of both worlds. The best reason for disabling shadowing in the first place is to reclaim the area of RAM that shadowing takes away (the upper 384K of the first 1MB). The video board's shadowing, when enabled, takes up only about 64K; thus you get the speed advantage of shadowing without paying the full 384K price. Meanwhile, the motherboard's system shadowing can be enabled without disabling the video board's shadowing; it takes up 128K when used.

Beyond this, the EXP 386SX is fairly conventional. The motherboard runs at a no-risk 8 MHz for full compatibility with expansion boards, and it lets you select zero, two, or four wait states, depending partly on the speed of your memory chips. A turbo switch on the small-footprint case lets you downshift to 8 MHz if necessary. The unit's eight expansion slots—two 8-bit and six 16-bit—shrink to five available ones after you've installed video, disk controller, and I/O card.

Express Micro Mart offers a solid customer support policy. First, there's the usual one-year parts-and-labor warranty, with direct support provided by the company. During this time, you can ship a part back and receive a replacement by express mail. In addition, for a yearly fee you can receive on-site service from TRW; this fee varies according to your configuration. Service for the bare-bones system, for example, would cost $49, while our tested configuration would require $79.

So far, documentation for the machine appears sparse, with only slim manuals available for individual parts like the motherboard, video card, disk controller, and keyboard, all packed in a large envelope. By the time you read this, however, Express Micro Mart intends to have a comprehensive manual completed that it will include with the current documentation.

Still searching for a low-cost 386SX? The Express Micro Mart unit's share of quirks may be enough to make you look elsewhere and spend a few more dollars. But if you want the most machine you can get for a reasonable price and you find the company's reasonable warranty policy reassuring, the Express 386SX may be worth hopping aboard.

FACT FILE

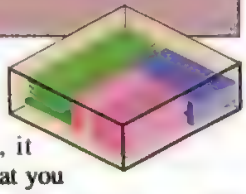
EXP 386SX
Express Micro Mart Inc., 5520 Drake Rd., West Bloomfield, MI 48322; (800) 533-0177, (313) 788-0133.
List Price: With 512K RAM, 30MB hard disk, 1.2MB 5.25-inch floppy disk drive, monochrome monitor, one parallel and two serial ports, $1,089; with 2MB RAM, 66MB hard disk, super VGA monitor, game port, DOS 3.3, $1,818.
In Short: Express Micro Mart's EXP 386SX generally follows the standard formula for an SX machine, but gets mixed results on PC Labs' benchmark tests. Look here for a decent, low-cost model with a solid warranty.

CIRCLE 424 ON READER SERVICE CARD

FORTRON/SOURCE CORP.

Fortron NetSet 386SX

by Bill O'Brien



A few years ago, if you knew the Fortron name at all, it probably meant that you had looked inside a PC or AT compatible and seen the name on the power supply. That's what the company made then, but from little power supplies mighty systems sometimes grow. Fortron/Source now wraps its power supplies in computer components. Among its other models, the company's $1,750 NetSet 386SX has blossomed into a machine with above-average coprocessor and hard disk speeds.

Fortron's own motherboard sits on the floor of the 5.25- by 15.5- by 14.75-inch enclosure and includes a Chips and Technologies chip set and Phoenix BIOS. The January 1988 BIOS date hints that the original design was intended for the 286 environment, which the physical layout of the motherboard seems to confirm; it actually appears to be a 286 board with a 386SX platform tucked into the space originally occupied by the 80286. There are many overall similarities between 286 and 386SX systems, however, and the early BIOS date probably has little effect on the machine's performance. The NetSet's performance problems mainly occur in the areas of memory and video speeds.

The tested machine came stuffed with 2MB of RAM, but even 200MB would not have helped the feeble score on PC Labs' Conventional Memory test. Thanks to the chip set's fast processor activity, however,

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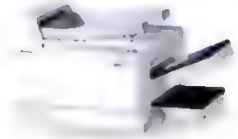

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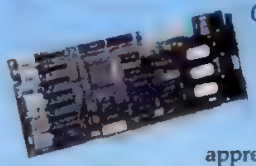

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CPU-Upgrades to 486	No	No
Motherboard Manufacturer-AMI	?? Changes??	?? Changes??
RAM-28 MB max.	16 MB max.	16 MB max.
Hard Drive-151MB or 200MB	150 MB	200 MB
Video- Sony 1304 "EDITOR'S CHOICE" NON-INTERLACED	Tatung (Generic) INTERLACED	NEC-3D INTERLACED
Tower-NO CHARGE	$200 Extra	NO CHARGE
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Fortron NetSet 386SX
Fortron/Source Corp., 6818-G Patterson Pass Rd., Livermore, CA 94550; (800) 821-9771, (415) 373-1008
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, monochrome monitor, one parallel and one serial port, mouse port, DOS 4.01, $900; with 2MB RAM, 60MB hard disk, VGA monitor, $1,750; with 80MB hard disk, mouse, $2,295.
In Short: The Fortron NetSet 386SX performs well on most tests except for video. But with an upgrade to a 16-bit VGA card, it moves into more desirable territory, especially in the light of its large IDE hard disk.

CIRCLE 425 ON READER SERVICE CARD

the NetSet managed to slip into the top third of the Floating-Point Calculation test scores. While not a screamer, the machine is certainly no slouch when the computing task involves intensive processor and RAM interaction.

Hard disk performance also rose above average, which is not surprising since the test machine came equipped with an 80MB Conner hard disk using Conner's IDE controller. This small, economical disk drive provides mass storage without gobbling up much of the NetSet's interior space or doubling its cost; thus the machine is competitive for the general office environment as well as offices at home.

By contrast, the video test scores fell remarkably below the norm. Certainly the quality of the chip set on the video card did not cause the drop-off, since the NetSet comes with a Cirrus Logic chip set mounted onto Fortron's own VGA card. The card's 8-bit interface, a lost cause at today's levels of technology, deserves the blame. Apparently Fortron also recognizes the problem, and it now offers a 16-bit VGA card at a $15 increase over the former price.

The Fortron's 101-key keyboard does not suffer from disadvantages like the video display system. It feels like a solid unit, offering an unobtrusive key-switch response and mild resistance. Likewise, the Logitech mouse is up to the usual Logitech standards for alternative input devices.

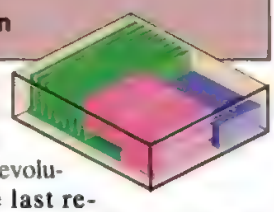
The NetSet's main selling point, however, is Fortron's service policy. Fortron guarantees the equipment for a year, and this is backed by the company's telephone technical support. Much like Gateway, Fortron also provides a fall-back on-site service policy through GE Computer Services should the teleservice fail to resolve a problem. Naturally, on-site service may be limited to situations where Fortron considers it necessary.

The Fortron NetSet 386SX wears a slightly higher price than some of the other computers reviewed here, but its larger and faster hard disk seems a good swap for a few extra dollars. It definitely belongs on the list of machines to consider.

GATEWAY 2000 INC.

Gateway 2000 80386SX

by Bill O'Brien



The 16-MHz Gateway 2000 80386SX has undergone an evolution since we last reviewed it (see "386SX: The New Corporate Standard," *PC Magazine*, January 30, 1990). In its current incarnation, the desktop unit is packed with goodies and tagged at an attractive $1,850 price that includes 2MB of RAM, a 65MB Microscience hard disk, 1.2MB TEAC floppy disk drive, 256K VGA display system, and DOS 4.01. The cost looks even better when you take into account Gateway's customer support policies, well-written manuals, and exceptional processor and memory performance.

Gateway appears to have found a winning combination of components for its machine. Inside the AT-style desktop case rests an FTK motherboard armed with a Chips and Technologies NEAT chip set and loaded with an AMI BIOS dated December 1989; 2MB of 80-nanosecond

Gateway 2000 80386SX
Gateway 2000 Inc., 610 Gateway Dr., North Sioux City, SD 57049; (800) 523-2000.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one serial and two parallel ports, DOS 4.01, $1,095; with 2MB RAM, 65MB hard disk, VGA adapter (256K) and monitor, $1,850; with ATI Wonder VGA adapter (512K), $1,895.
In Short: With a low price, reasonable performance, and a one-year warranty, complete with on-site service when necessary, the Gateway 2000 80386SX comes close to the ideal.

CIRCLE 426 ON READER SERVICE CARD

RAM grace the motherboard in two SIMM banks. The 80386SX runs off with second-place honors on PC Labs' 80386 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests. The page-interleaved RAM arrangement (running at zero wait states) deserves credit for the excellent test results.

To maintain a good price/performance ratio, Gateway has made a small compromise with its RLL-type hard disk. Our disk test results place that drive in the bottom half among the machines that we have evaluated here. If you positively, absolutely must have rapid data transit, Gateway can supply you with any number of other drives in ESDI, SCSI, or IDE configuration for an added price.

In our tested system, a 16-bit ATI VGA Wonder card, pumped up to 512K of video memory and super VGA capability, handled the video chores. ATI makes an excellent board, but as the video benchmark tests show, it needs the benefit of the 80386SX's video shadowing to deliver superior speeds. Overall performance as tested, with shadowing off, falls into the midrange.

Two excellent manuals arrive with the

80386SX; they focus mostly on hardware operations rather than any applications environments, but they manage to break down most of the technical jargon into understandable English. If you need help with your machine, technical support is available by phone, as it is with most SX vendors. In our experience, the support-line service was satisfactory.

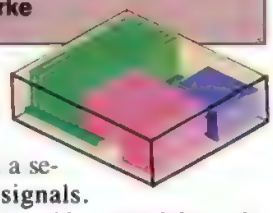
The Gateway machine's warranty provides the pleasantest surprise. If you find a problem with a component, simply send it back to Gateway and a replacement soon arrives. Nevertheless, since we're not all expert diagnosticians and hardware installers, Gateway will arrange for a repair person to perform on-site service if the problem can't be resolved over the phone. To protect itself against abuse of this policy, the company reserves the right to make the final decision on whether on-site service is actually required.

Given its ratio of price to performance, the Gateway 2000 80386SX is a hard computer to pass up if you're shopping for a 16-MHz 386SX system. When you factor in the service policy, it becomes as close to a mandatory purchase as anything ever has been.

HIQUALITY SYSTEMS INC.

HiQ386SX-16/20

by Fredric Burke



HiQuality Systems' HiQ386SX-16/20 sends out a series of mixed signals. Judging from the outside, you might say its huge case and imposing fascia styling promise Olympian performance and capabilities. Combine that with a standard-configuration price tag of $1,960 and you may think you've stumbled onto one of the world's great performance bargains. Take a look inside the machine, though, and the promise gradually fades, partly but never completely disappearing. The HiQ doesn't offer as many expansion slots as it should, even though it contains more room for drives and internal devices than most machines in its class. It will do as good a job as most other 386SX machines—but not always as quickly as its competitors.

The HiQ's hardware configurations seem acceptable at first glance. The basic configuration costs $795 and comes with a choice of 1.2MB or 1.44MB floppy disk drives. The Chicony motherboard packages a standard 1MB of interleaved page-mode 80-nanosecond SIMM RAM, in 256-kilobit DRAM chunks, which you can expand to 8MB eventually. Unlike some other 386SXs, this one does not require you to replace the 256-kilobit chips with 1-megabit chips to expand the RAM. You also face the option of purchasing an add-in memory board—unusual for a 386SX machine in this price range—since the 16-bit Chicony unit allows users to bump the machine's memory up to 16MB. It packages the extra RAM in 1-megabit DIP chips, at $120 a megabyte.

Speedup features include software-switchable wait states that permit settings of 0 or 1. AMI's BIOS allows for RAM shadowing in both system and video modes. The HiQ will also support an 80387-SX math coprocessor ($335), which was not included in our tested machine. HiQuality can also replace the system's 16-MHz clock with a 20-MHz-rated one, but this option is of dubious useful-

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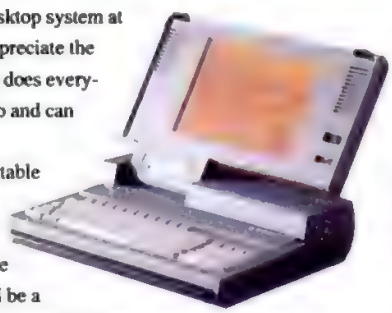

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CPU	80386SX-16	80C286-12	80386SX-16	80386SX-16	80386SX-16
RAM(STD/MAX)	1/4 MB	640 KB/3.6 MB	2/4 MB	1/13 MB	1/8 MB
DISPLAY	Gas Plasma/VGA	LCD/VGA	LCD/VGA	[illegible] Plasma/VGA	LCD/VGA
RESOLUTION	640*480	640*480	640*400	640*480	640*480
KEYBOARD KEYS	85 (detachable)	81	89	91	79
KB.KEYPAD PORT	Yes	Yes	N/A	Yes	Yes
3.5 FDD	1.44 MB	1.44 MB	1.44 MB	1.44 MB	1.44 MB
HDD	40 MB	40 MB	40 MB	40 MB	40 MB
SERIAL PORT	2	1	1	2	1
PARALLEL PORT	1	1	1	1	1
VGA PORT	Yes	Yes	Yes	Yes	Yes
EXT.FDD PORT	5.25"	5.25"	5.25"	5.25"	5.25"
I/O EXP.SLOT	2	2	2	(6)	3
SIMULTANEOUS INT/EXT DISPLAY	Yes	No	No	Yes	No
SEPARATE FDD/PRINTER PORTS	Yes	No	No	No	No
WARRANTY	18 Months	12 Months	12 Months	12 Months	12 Months
LIST PRICE	$5,000	$5,999	$8,499	$6,299	$8,799

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CIRCLE 371 ON READER SERVICE CARD

ness since the bus speed remains unchanged at 8 MHz. Standard software includes a disk-caching utility, setup and diagnostics programs courtesy of AMI, and other speedy utilities. HiQuality supplies DOS 3.3 or 4.01 on the hard disk; for $70 you get the documentation as well.

The HiQ's case is a throwback to the days when everything looked like the old IBM PC AT. At 6 by 21 by 16 inches, the HiQ turned out to be one of the biggest machines tested for this review. The case's control panel shows the lock, reset buttons, and turbo switch. Knockout panels for three half-height floppy disk drive bays sit on the right.

A look inside the case reveals a great deal of wasted space, with room allocated for only two 8-bit and six 16-bit slots. The DTC floppy/hard disk controller, one parallel and two serial ports, and the video card are installed. That leaves five slots available, four of them 16-bit and one 8-bit. For a chassis this big, there should be more. Nor is the chassis as solidly constructed as it should be; the motherboard flexed when I moved components inside the case.

The HiQ bristles with drive bays. Five easily accessible bays that can function either as two full-height or five half-height bays sit stacked next to each other. DTC's disk controller card and a fairly swift 24-millisecond 65MB TEAC hard disk posted above-average timings on two of our three disk tests. HiQuality offers eleven more hard disk options, ranging from a 40MB RLL at $335 to a 330MB ESDI at $1,500. These drives are most often made by NEC or Toshiba, and HiQuality reports that you are more likely to get one of these brands when you purchase a 65MB disk.

> One of the biggest machines tested, the HiQ's case is a throwback to the days when everything looked like the PC AT.

A 1.2MB floppy disk drive also comes standard on the HiQ; if you prefer, you can specify a 1.44MB drive when ordering the machine. Adding one later costs an additional $80. Given the number of internal drive bays, I would have preferred that two of them be sacrificed for another 16-bit expansion slot, but that wasn't an option.

The HiQ's standard 16-bit Prolink video card, governed by an Intel chip set, displayed moderately fast video performance on our benchmark tests. HiQuality normally supplies a Relisys VGA monitor but will package nearly any display the customer requests. Similarly, the company will supplant the standard clickety Key Tronic 101-key keyboard with either a softer-touch Maxi-Switch or an even more clickety Chicony. A whisper-quiet 230-watt device is the machine's standard power supply. HiQuality also offers a 60MB tape drive as a $385 option.

The company provides a one-year warranty and a 30-day money-back guarantee. HiQuality has established a toll-free technical support line, but currently it does not

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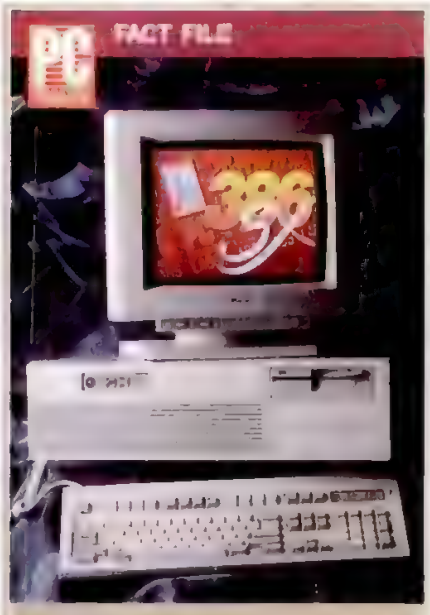
plan to offer on-site service. If HiQuality can't resolve a problem with a component by phone, you ship the equipment back for repair to HiQuality's facilities in Sunnyvale, California. Unfortunately, this may be necessary even if you're accustomed to probing inside your machine. The technical information supplied in the manual, with its anemic text and diagrams, did not seem particularly helpful.

The HiQ386SX-16/20 has the potential to be a big, brawny packhorse of a computer, made to be loaded down. Its 80386 Instruction Mix performance, which ranks at the bottom of the machines tested, and its low scores on a few of the other tests show that the machine behaves unevenly, with some speedy components and other slower ones.

Nevertheless, its strengths outshine its weaknesses. For the price, it comes as well equipped as any other machine in its class. And with all its drive bays, it offers more expandability, though a machine this big is cheated by having fewer slots than it might. The HiQ is not a glamorous performer, but it functions effectively.



HIQ386SX-16/20
HiQuality Systems Inc., 740 N. Mary Ave., Sunnyvale, CA 94086; (800) 827-5836, (408) 245-5836.
List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, game port, $795; with 2MB RAM, 65MB hard disk, VGA monitor, DOS 3.3 or 4.01, $1,960.
In Short: The HiQ386SX-16/20 allows the user a wide latitude at system configuration time. Nevertheless, its considerable size and sluggish processor work against it. This is a worthy effort but stands in need of work.

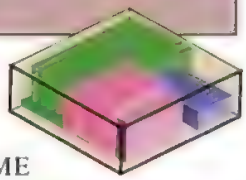
CIRCLE 427 ON READER SERVICE CARD

COMPUTERS
CHEAP SXs

MICRO EXPRESS

Micro Express ME 386SX

by Bruce Brown



In a world of look-alike 386SXs, the Micro Express ME 386SX stands out as one of the best. Whether your priority is saving space, maximizing memory or drive expansion potential, achieving higher performance, getting the lowest price, or securing the best service and support policies, the ME 386SX keeps popping up as a top candidate.

The small-footprint ME 386SX measures 7 by 15 by 16.25 inches. Our tested machine came with 2MB RAM, an 84MB 24-millisecond Quantum IDE hard disk, 1.2MB floppy disk drive, 16-bit VGA display adapter, Samsung color VGA monitor (800 by 600 resolution), 101-key Maxi-Switch keyboard, one parallel and two serial ports, and DOS 3.3. This system lists for just $1,699.

If you want to build a custom version you can start with a basic-configuration system for $759, which includes 1MB RAM, a floppy/hard disk controller, the 1.2MB floppy disk drive, I/O ports, keyboard, and power supply. If you are willing to accept a system with a house-brand monitor, Micro Express offers a configuration that includes a color VGA monitor with 1,024 by 768 resolution for the same price as the lower-resolution Samsung monitor with its more recognizable brand name.

In the past, Micro Express sold mail-order computers that were built using third-party motherboards. The ME 386SX is the first Micro Express machine to use the company's own motherboard design. This design indicates that the Micro Express developers knew what they were doing. The board includes the well-respected Chips and Technologies NEAT 386SX chip set, Phoenix ROM BIOS, and support for video and system ROM shadowing. The system runs only at zero wait states and uses page-mode memory interleaving.

You can expand the ME 386SX motherboard to 4MB RAM using 80- or 100-nanosecond DIP chips. The machine has a proprietary memory expansion slot (an unusual item for an SX design), which holds a $140 optional memory card. This card can hold up to 12MB, increasing the system maximum to 16MB. Many people who need that much memory will probably buy a regular 386 computer, but still it's comforting to know the expansion potential exists. Better yet, you don't lose a slot if you choose not to use the memory expansion card, since the slot can also accept any standard 8-bit cards.

In all, the ME 386SX has eight expansion card slots: three 8-bit (counting the slot for the memory card) and five 16-bit. Our tested machine used two slots: one for a combined disk interface and I/O card, and one for the video card. An ample six slots remained open. Due to their positioning in the chassis, however, one 8-bit and one 16-bit slot are restricted to using half-length cards.

The machine features three half-height drive bays and two 3.5-inch bays. All but one of the 3.5-inch bays are capable of

Micro Express ME 386SX
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; (800) 642-7621, (714) 852-1400.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, one parallel and two serial ports, $759; with 2MB RAM, 84MB hard disk, VGA monitor, DOS 3.3, $1,699
In Short: The small-footprint Micro Express ME 386SX performs significantly above average on most tests and is priced to please. The company's 15-month parts-and-labor warranty and liberal support policies form an aggressive combination that could be improved only by on-site service.

CIRCLE 428 ON READER SERVICE CARD

holding a device that uses removable media. But if you use five drives you'll need a power-splitter cable, since the power supply has only four leads. Overall, with sufficient room for additional drives, cards, and memory, this small-case SX machine is especially prime for system expansion.

The ME 386SX did very well on PC Labs' benchmark tests. All scores were above average—in some cases dramatically so—with the sole exception of the Floating-Point Calculation test, which had a very low score.

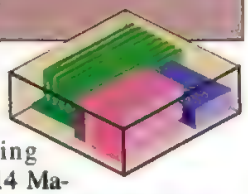
Micro Express goes one step further than most direct-sales vendors in service and support. The company offers a 15-month parts-and-labor warranty along with a 30-day money-back guarantee. There is no on-site service contract. But if you report a problem (using a toll-free technical support number) at any time during the warranty period, Micro Express will send a new replacement part overnight. If you must send the whole system in for service, the company will pay shipping both ways. Most vendors pay for shipping only one way, so once again Micro Express looks very good.

If there's a 386SX in your future, here's the one to buy. Price? Performance? Expansion? Service? Micro Express has it all.

MITSUBA CORP.

Mitsuba MIT-SXA

by Ed Perratore



When *PC Magazine* last reviewed Mitsuba's SX offering ("Out in Force: 14 Machines with the SX Promise," August 1989), *expansion* was the operative word. The AT-sized Mitsuba 386SX Workstation seemed mediocre in its performance speed and overpriced at $4,420, but it featured a hefty five half-height drive bays and eight expansion slots.

The Mitsuba MIT-SXA, as it is now called, has since gone on a diet—in price, size, and components. It has slimmed down to a sturdy, small-footprint machine measuring 17 inches wide. It also lost one of its drive bays. As for performance, in this latest incarnation, it scored above average on several of PC Labs' benchmark tests, although it stumbled on a few others.

What has slimmed down most is Mitsuba's price. The machine now costs $2,295 in our standard configuration. In fact, for $1,250 you can have a basic system with 1MB RAM, a DTC floppy/hard disk controller, a 1.2MB or 1.44MB floppy disk drive, Hercules monochrome monitor, one parallel and two serial ports, EMS software, and DOS 3.3. Our tested machine added 1MB RAM, a 67MB Toshiba hard disk, VGA card and monitor, and a game port, for the aforementioned total of $2,295. This is still a fair price for a 386SX system.

While brand-name parts don't always ensure reliability, Mitsuba doesn't take risks on lesser-known names in selecting its components. The five hard disk options available come from Toshiba; the floppy disk drives are from Epson. Our tested system's video card is Western Digital's and uses the Paradise chip set. The VGA monitor and I/O card are Mitsuba's own.

Perhaps because of occasional shortages of 1-megabit chips, the MIT-SXA usually arrives populated with 256-kilobit RAM chips, as many of the machines reviewed here do. If you want to expand the computer's memory to its 5MB maximum, you need to remove all the 256Kb chips and replace them with the 1Mb variety. Through its dealers, Mitsuba offers a reasonable buy-back policy for the 256Kb chips, reimbursing the full dealer price less 15 percent if you upgrade within three months of purchase. This 15 percent gradually increases to a maximum of 40 percent over two years. Mitsuba is one of the few vendors with any type of buy-back policy. Still, the safest bet is to buy a machine configured with 1Mb chips.

Ironically, Mitsuba's RAM marketing strategy outshines its RAM performance speed. On PC Labs' Conventional Memory test, the MIT-SXA ranked below average among the machines reviewed. It scored somewhat better on the processor tests, however—a tribute to the Mitsuba motherboard and Chips and Technology chip set. The American Megatrends BIOS allows you to enable or disable system and video shadowing and to select one or zero wait states.

The MIT-SXA ranked in the upper third of the machines on our Direct-to-Screen video benchmark test, yet it was in the bottom half on the Video BIOS Routine tests. Likewise, the hard disk/controller combo was vanquished on the small-record DOS File Access test, but it rose to the occasion for the other two disk tests, scoring in the top half of the pack.

True, these scores represent mixed results, but the Mitsuba MIT-SXA has obviously been carefully constructed—from the makeup of its parts and sturdy case through its comprehensive documentation (not to be taken for granted among low-cost machines) to its one-year warranty and optional on-site service. The MIT-SXA is no screamer, but if reliability and reasonable pricing are your aims, this one surely deserves your attention.

PC FACT FILE

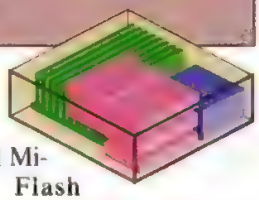
Mitsuba MIT-SXA
Mitsuba Corp., 650 Terrace Dr., San Dimas, CA 91773; (800) 648-7822 (outside Calif.), (714) 592-2866
List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, 14-inch monochrome monitor, one parallel and two serial ports, EMS driver, DOS 3.3, $1,250; with 2MB RAM, 67MB hard disk, VGA monitor, game port, $2,295
In Short: The MIT-SXA features solid construction and reliable brand-name parts, although it gave a mixed performance on our benchmark tests. Speed notwithstanding, the vendor's reasonable RAM buy-back policy, comprehensive documentation, and overall price make this machine worth a good look.

CIRCLE 429 ON READER SERVICE CARD

NATIONAL MICRO SYSTEMS INC.

Flash 386SX-16

by Bill O'Brien



With its standard configuration priced at $1,779, National Micro Systems' Flash 386SX-16 may not sound too radical, but

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Instant Recall is always just a keystroke away—yet it needs only 32K of memory

Hardware Compatibility
IBM PC, XT, AT, PS/2, or compatible, 512K RAM (32K RAM in background mode), DOS 2.1 or higher (DOS 3.0 or higher for memory resident operation), at least 720K capacity on a single floppy or hard disk.

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Instant Recall lets you pull together notes, tasks, schedules, and people information on a *single screen—by topic, date, person, priority, or embedded text*.

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Instant Recall is the *only* general purpose PIM which offers a pop-up activity timer, a phone dialer, alarm messages, scheduling and tasks for multiple individuals and groups, automatic conflict checking, advance notice, and recurring activities.

Other convenient features include mailing lists and labels, direct copy of name and address to any word processor, overdue notice, follow-up dates, password protection, flexible printed reports, and a clipboard for exchanging text with other programs.

CIRCLE 117 ON READER SERVICE CARD

Ready to use right out of the box

Instant Recall comes ready to work for you from day one. An intuitive user interface and context-sensitive help make it exceptionally easy to learn and use. You don't have to retype information that's already on your computer—Instant Recall has a built-in clipboard for pulling information directly from other programs and ASCII files. Plus transfer utilities for Sidekick,® Tornado™, MemoryMate,® and delimited ASCII files.

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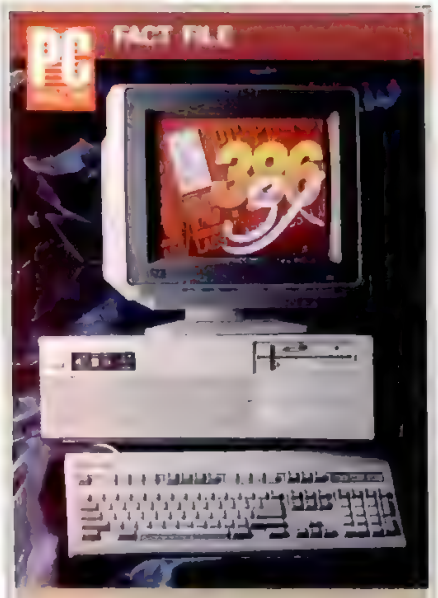


Flash 386SX-16
National Micro Systems Inc., 2833 Peterson Pl., Norcross, GA 30071; (800) 642-7649, (404) 446-0520
List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, game port, $799; with 2MB, 65MB hard disk, VGA monitor, DOS 4.01, $1,779.
In Short: With the battle lines drawn on the SX frontier, National Micro Systems has brought out its artillery. The processor and memory times could be better, but the price level more than compensates for a little lost time.

CIRCLE 542 ON READER SERVICE CARD

when you see its basic-configuration price of $799 you may think your eyes are deceiving you. The truth is: at that price it's not a usable computer. Once the unit is fully configured, its hard disk performance rates extremely high, but its poor results on our processor and memory benchmark tests drag the machine into the middle of the pack.

The Flash 386SX-16 doesn't exactly qualify as a true small-footprint machine. Its AT-style box is only slightly narrower than the standard PC AT; it still leaves a few inches for piles of paper on your desk.

The platform is a Chicony 16-MHz motherboard with an Intel chip set and AMI BIOS. With the standard fare of disk controller, video, and I/O interface cards installed, the eight-slot board still has one 8-bit and five 16-bit slots free, providing ample room for expansion. The 200-watt power supply can feed even the heaviest combination of add-in boards.

Our tested machine arrived with 2MB of 80-nanosecond RAM in DIP configuration. The motherboard makes provision for 4MB of DIP and 4MB of SIMM memory, all operating at zero wait states, in an interleaved page mode. Despite this fast RAM arrangement, the Flash 386SX-16 failed to hold its own on PC Labs' 80386 Instruction Mix, Floating-Point Calculation, and Conventional Memory tests: it had the worst memory access time and was one of the slowest four or five computers on the other two tests.

On the other hand, the 65MB Toshiba RLL hard disk was a winner. Although the disk drive has a middle-of-the-road track-to-track access time (BIOS Disk Seek), it surpassed itself on the DOS File Access tests. Obviously, the combination of the Toshiba hard disk and the Western Digital controller looks like a champ.

The Flash 386SX-16 contains a 16-bit Paradise Plus video card with Paradise's own chip set. The card and monitor combination consistently produced crisp graphics and sharp text characters. The Paradise card responded well on our Direct to Video test but suffered slightly on the Video BIOS Routine tests, especially when scrolling. Enabling video BIOS shadowing should boost this performance.

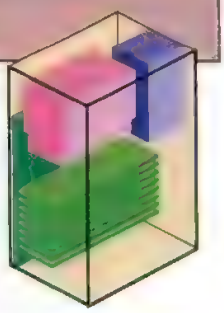
The keyboard is a genuine Maxi-Switch. While Maxi-Switch has quite a few models to choose from, National Micro Systems has selected a lightweight device with a rather soft feel. This keyboard will be the bane of ham-fisted typists; if you have a light touch you'll like it.

The performance of the Flash 386SX-16 was uneven, although it may be worth considering as a low-cost, interim machine. The hard disk system stands out as a quality investment, worthy of consideration for a transplant into a future PC purchase. The rest of the components are functional but nothing to rave about.

NOVACOR INC.

Novas 386SX-16

by Fredric Burke



Novacor's Novas 386SX-16 is an okay performer, but it didn't exactly blow its competitors to the winds. Its specifications, in its $1,850 standard configuration, may not stand out in a crowd. But sometimes numbers and descriptions don't tell the whole story. The Novas 386SX-16 excels in less quantifiable measures: design, detail, and execution.

Novas 386SX-16
Novacor Inc., 1841 Zanker Rd., San Jose, CA 95112; (800) 486-6682.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, monochrome monitor, one parallel and two serial ports, $995; with 2MB RAM, 60MB hard disk, VGA monitor, DOS 3.3, $1,850; with 70MB hard disk, $1,910.
In Short: The Novas 386SX-16 is practical and useful, although it generated slow scores in our testing. Its functionality and quality construction make it one of the better machines.

CIRCLE 543 ON READER SERVICE CARD

The bare-bones version of this machine won't get you very far. $995 provides 1MB of RAM, a TEAC 1.2MB floppy disk drive, a monochrome monitor, one parallel and two serial ports, and no hard disk. But the price for our tested machine could bring a smile to your face. At $1,910, it contained 2MB of RAM, a 70MB RLL hard disk, a Relisys VGA monitor, and a Maxi-Switch 101-key keyboard, and DOS 3.3. If you prefer, a TEAC 1.44MB floppy disk drive or a Key Tronic keyboard can be substituted. The purchase price includes a one-year warranty contract for depot service (you ship the unit to the manufacturer). Extended plans are available; on-site service is not.

As reflected in our standard configuration, Novacor can supply either DOS 3.3 ($75) or DOS 4.1 ($85) as options. These represent the only software Novacor currently offers with its machine, although it does intend to bundle a disk-caching program soon.

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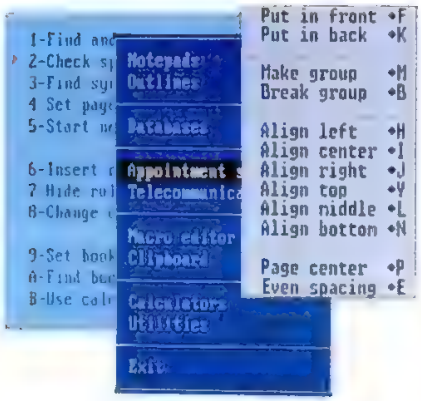

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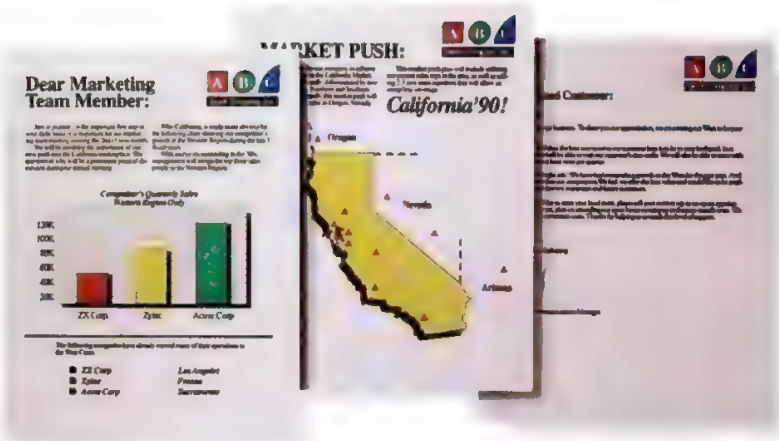

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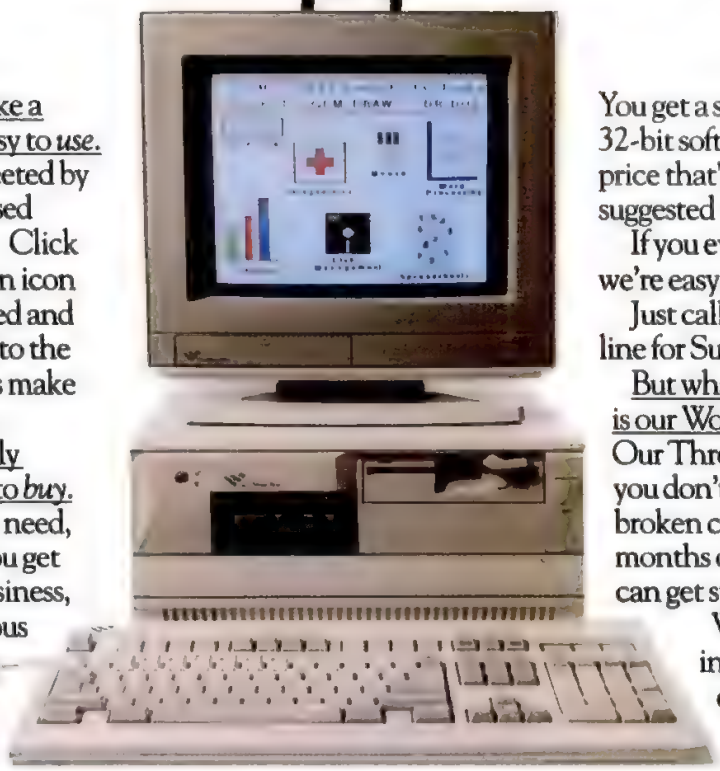

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Sun Moon Star™

board for the Novas. This uses an Intel chip set and comes equipped with 2MB of interleaved page-mode RAM. RAM can be expanded to 8MB using 256-kilobit 80-nanosecond chips; the upgrades cost $112 per megabyte. The AMI BIOS allows for switchable wait states—either zero, one, or two—and bus speeds too can be switched between 5 and 10 MHz. The motherboard supports the Intel 80387-SX math coprocessor, which Novacor supplies for $395. The company does not offer an add-in board for RAM expansion beyond the motherboard's 8MB.

The Novas machine achieved its highest scores on the processor and memory tests, with moderately slow scores on the disk tests. The video test scores reflected the bog-slow performance of the Novas 3000 VGA card that comes standard as an 8-bit device. An optional 16-bit VGA card boosts performance significantly and is worth the additional money.

Expandability is the Novas's strong point. Even with the DTC floppy/hard disk controller in a 16-bit slot, and the video and I/O cards each occupying 8-bit slots, an 8-bit slot and four 16-bit slots remain available. Most small-footprint machines sacrifice slots for compactness, but the Novas's minitower case, measuring 17 by 7.5 by 16 inches, takes up less room on your desk and still allows for substantial expansion.

The Novas supports a maximum of one 3.5-inch and three half-height drives. The tested unit came with a 70MB Seagate, but the plentiful hard disk options range from a 20MB MFM ($210) to a 676MB SCSI ($2,675).

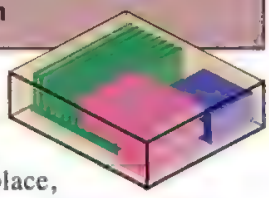
The machine looks aesthetically pleasing as well. The chassis and case seem sturdily constructed, neatly finished, and free of the flex that plagues many inexpensive machines. Drives are located at the top of the case, while beneath it is mounted a control panel containing an on/off switch, reset button, hard disk light, turbo button, and lock. Underneath the controls lies a cross-hatched cooling panel. Inside the machine you'll find a quiet 200-watt Leadman power supply and ample room for drives, cabling, and boards.

The Novas 386SX-16 suffers a bit from limited software offerings and a lack of RAM expansion past 4MB. The machine is well constructed, with quality components, and while the video performance was slow, processor and memory performance were fine and the price is attractive. Don't overlook the Novas 386SX-16.

PAN UNITED CORP.

PC 386/SX Business System

by Bill O'Brien



Pan United has become a prolific company in the marketplace, but it hasn't forgotten the importance of providing a good deal. Its desktop-sized 386SX, now called the PC 386/SX Business System, has kept pace with the pack; our standard configuration is $2,270, and the $1,995 base price has dropped more than $200 since we last examined the machine in a similar configuration ("386SX: The New Corporate Standard," January 30, 1990). Best of all, there's no loss of performance with the new price tag. The PC 386/SX did fairly well on our video tests, although its processor, memory, and disk benchmark test times fell decidedly below average.

An AT-style case with front-mounted turbo and reset buttons still houses the machine, but it has undergone some under-the-hood changes. The PC 386/SX platform is now an Amptron motherboard with an Intel chip set. A Phoenix BIOS directs operations, although the date stamped on the BIOS (January 15, 1988) suggests that it would be better tailored for a 80286 system. Discovering such an ancient creation date on this machine's BIOS is disconcerting, even though it should work fine in an SX machine. One benefit of SX technology is that its external connections are roughly equivalent to the older 80286.

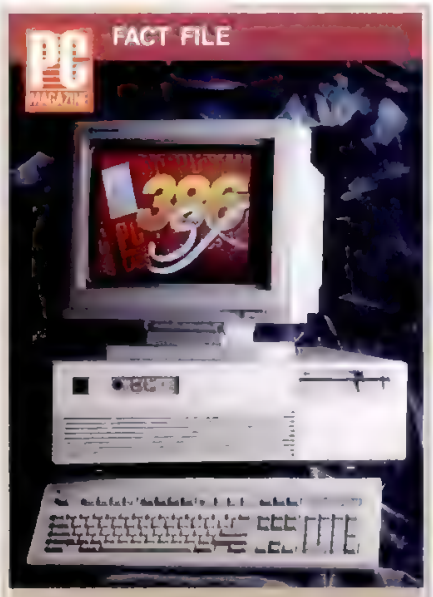
Both the base and the review unit include four banks of 256-kilobit SIMMs operating at 80 nanoseconds. Like any other 16-MHz SX computer, the Pan United unit contains no processor RAM cache. Despite the fast rated speed of its 2MB of memory and zero wait states, it bottomed out on PC Labs' Floating-Point Calculation benchmark test. The machine performed somewhat better on the 80386 Instruction Mix and Conventional Memory tests, though not measuring up to the competition.

The disk test results were also unimpressive. The 40MB Seagate ST-251 hard disk performed as well as you might expect for a low-cost MFM disk drive. Pan United lists both 150MB and 300MB ESDI disks as options, but bumping up the price of this 16-MHz SX machine by $1,200 or $1,500, respectively, doesn't make good financial sense. The increased cost puts you over the $3,000 plateau, which is the low end of the standard 20-MHz 80386 level—a better platform for continued expansion. Computers such as this PC 386/SX shine in a situation where the immediate needs and budget outweigh expansion requirements.

Pan United pays close attention to human interface factors. The tested unit included the Video 7 FastWrite VGA card, a multiscanning monitor, and the Chicony 101-key keyboard. The monitor provided sharp graphics and crisp text characters. The graphics card's ranking among the other tested machines on the Direct to Screen and Video BIOS Routine with Scrolling tests was fair to middling. Its relative position looked better on the Video BIOS Without Scrolling test. To boost performance, you can enable the video shadow RAM.

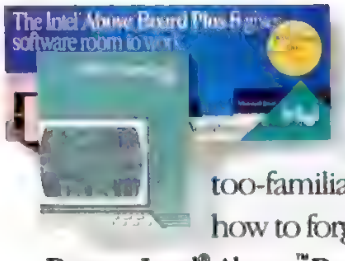
Evaluating the Chicony keyboard is a subjective matter. If you favor a mild tactile feel with audible switch feedback, you'll love it. If not, you won't.

FACT FILE



PC 386/SX Business System
Pan United Corp., 1927 Route 27, #12, Edison, NJ 08817; (800) 433-3006, (201) 906-8044.
List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5.25-inch floppy disk drive, VGA monitor, one parallel and one serial port, DOS 4.01, $1,995, with 2MB RAM, 60MB hard disk, $2,270.
In Short: The PC 386/SX Business System falls somewhat below average in processor, memory, and disk performance but does better in video speed. Its price is fairly typical of SX machines.

CIRCLE 544 ON READER SERVICE CARD



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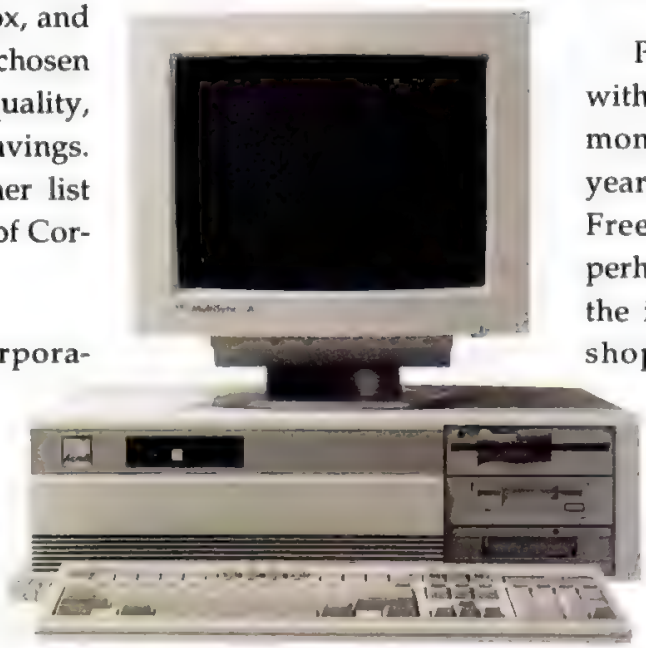

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PC Magazine Nov. 28, & Dec. 26 1989

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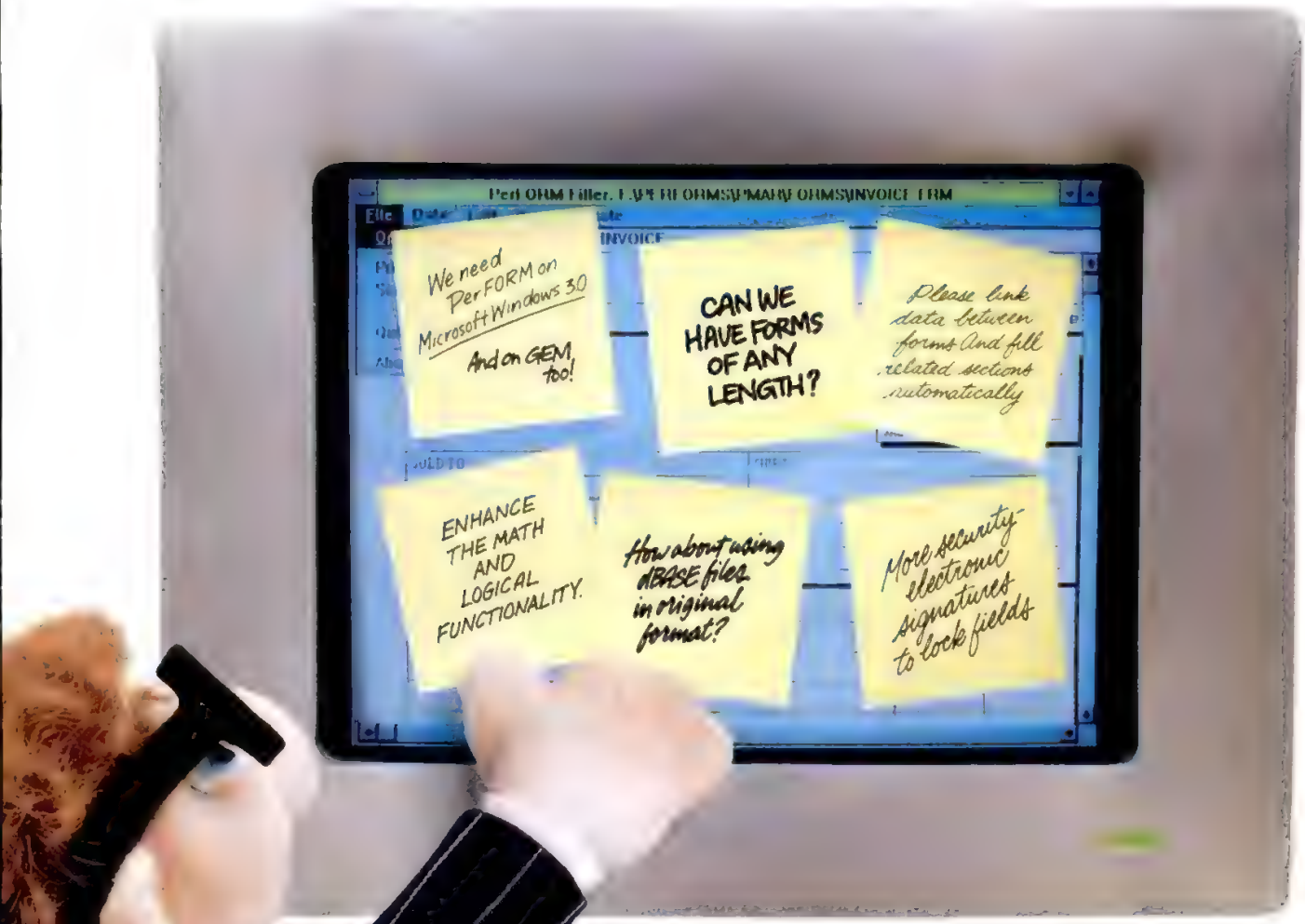

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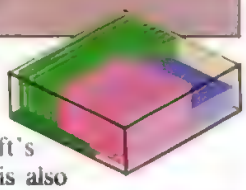
Pan United's customer support policies include a one-year warranty. If you have trouble with your system, you ship it back to the manufacturer.

All things considered, the PC 386/SX Business System is a solidly built computer with more-or-less average performance. But Pan United needn't feel ashamed of this *average* verdict. In fact, the East Coast could use a few more dependable "average" computer vendors.

PC CRAFT INC.

PCC 2260/16SX

by Ed Perratore



Generally sold through value-added resellers (VARs), PC Craft's PCC 2260/16SX is also available direct from the vendor and through dealers. Based on price, this small-footprint machine falls into the high end among the computers reviewed in this roundup ($2,364 for *PC Magazine*'s standard configuration). Based on performance, it emerges in the middle—a slowpoke on a few tests, a whizbang on others.

When this company offers a bare-bones machine, it means bare bones. The $1,395 basic configuration comes with 1MB RAM, a 1.2MB floppy disk drive, and an MFM floppy/hard disk controller. It does not include a hard disk. And although it comes with Alpha Software's integrated package *AlphaWorks*, it has no DOS. Also missing from this configuration are a video adapter and monitor, and I/O ports. A Hercules-compatible monochrome monitor and video adapter, which includes a parallel port, adds $179 to the price. And you should also factor in a $49 I/O card.

Our $2,364 tested configuration added another megabyte of RAM, a 60MB hard disk and RLL controller, a 14-inch PC Craft VGA graphics display and VGA adapter, one parallel and two serial ports along with a game port on an I/O card, and DOS 3.3. DOS 4.01 is available for the same price.

Memory expansion takes up a great deal of the physical space on the 2260/16SX's PC Craft motherboard—not because it allows any more than the common 8MB limit, but because these 80-nanosecond DRAMs require a combination of DIP banks and space-saving SIP modules to populate the board. Our unit's 2MB RAM was made up of 1-megabit chips, which the company claims it stocks in all its SX machines. The 1Mb chips are a good idea if you intend to add RAM later, since you won't need to replace any 256-kilobit chips with the 1Mb variety. Other motherboard features include a socket for an 80387-SX coprocessor, an Intel chip set, and an industry-standard 8-MHz bus speed.

The 2260/16SX's motherboard offers the usual number of expansion slots: two 8-bit and six 16-bit. But there's a hitch. The unit has three 5.25-inch half-height bays that can also be configured for one half-height and one full-height drive. Beside them to the left stand two vertical 3.5-inch bays. The vertical bays house either two 3.5-inch floppy disk drives or, as in our tested configuration, one 3.5-inch hard disk. Unfortunately, this arrangement partially blocks the insertion of full-length cards in the two rightmost 16-bit slots. For all practical purposes, the slots are rendered suitable only for three-quarter-length or half-length cards.

PCC 2260/16SX
PC Craft Inc., 640 Puente St., Brea, CA 92621; (800) 733-6666, (714) 256-5000
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, *AlphaWorks*, $1,395; with 2MB RAM, 60MB hard disk, VGA monitor, one parallel and two serial ports, DOS 3.3 or 4.01, $2,364
In Short: Below-average processor and memory benchmark test scores mar an otherwise decent machine that scored high on both video and hard disk tests. The PCC 2260/16SX's price, however, does nothing to make the machine the bargain it could be.

CIRCLE 545 ON READER SERVICE CARD

The American Megatrends BIOS, like that of several other machines in this review, allows enabling or disabling video and system shadow RAM during a setup procedure. To switch from zero to one wait state, however, you must change a jumper on the motherboard.

Our hard disk setup, a 60MB RLL NEC disk drive hooked up to an Adaptec controller, proved effective on PC Labs' disk benchmark tests. It scored in the top half of machines tested and pulled into the top fourth on the large-record DOS File Access test. Video performance also impressed us. The 16-bit Western Digital board shot up near the top on all three tests. The processor and memory tests, however, did little to justify the 2260/16SX's price. Our Floating-Point Calculation and Conventional Memory tests found the 2260/16SX in the lower fourth of the machines reviewed. The 80386 Instruction Mix score was also below average.

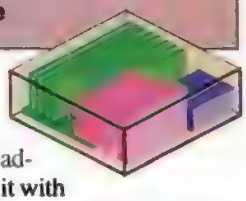
One warning: The company's literature notes that the unit is normally shipped with 100-nanosecond RAM chips. For optimum performance at zero wait states, double-check that the unit you purchase comes with 80-ns. chips. All configurations include a one-year warranty, with on-site service from Nationwide Warranty for the first four months.

Overall, the PCC 2260/16SX's performance does not quite live up to its price tag. The company notes that its list prices are regularly discounted 20 to 25 percent on the street, but let's face it: you can land the same discount on most other dealer-sold machines. The 2260/16SX has some attractions, including four months of on-site service, speedy video and hard disk performance, and a variety of custom configurations. But other SX models in this roundup offer similar strengths, and they do it at a better price.

PRECISION SYSTEMS GROUP INC.

PSG 80386SX/16

by Fredric Burke

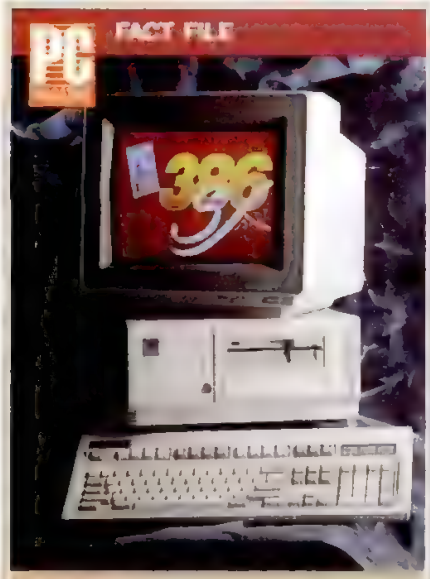


As the SX market grows more crowded, competitors jockey for advantage. Some try it with price, some with performance. Only a

few, like the PSG 80386SX/16, are able to succeed with both. With its standard configuration priced at $2,295, the PSG 80386SX/16 sits in the middle of the pricing spectrum rather than among the inexpensive prices of the other machines reviewed here. In most of our benchmark tests it scored among the top third of the machines we evaluated, although its scores on the DOS File Access tests were relatively slow.

The tested version came well suited for the competition. Precision Systems Group packages an 80MB IDE Conner hard disk and a 1.2MB TEAC floppy disk drive with a Conner floppy/hard disk controller into the diminutive (6- by 13.75- by 15.25-inch) small-footprint chassis. You can buy a 1.44MB drive as an option.

Everex supplies the fast 16-bit Viewpoint VGA video card, the parallel port and two serial ports, and the video utilities for the unit. CTX makes the VGA monitor; Key Tronic provides the slightly mushy but comfortable 101-key keyboard. PSG supplies DOS, and the user can specify either Version 3.3 or 4.01 when ordering the system.



PSG 80386SX/16
Precision Systems Group Inc., 3728 Phillips Hwy., #48, Jacksonville, FL 32207; (800) 326-4774.
List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, monochrome VGA monitor, one parallel and two serial ports, DOS 3.3 or 4.01, $1,575; with 2MB RAM, 80MB hard disk, color VGA monitor, $2,295.
In Short: The PSG 80386SX/16 exhibits speedy processor, memory, and video performance. The machine's basic configuration makes for a good beginning, but limited expandability works against it.

CIRCLE 546 ON READER SERVICE CARD

The Informtech motherboard can hold only 2MB of interleaved page-mode RAM, but PSG makes a RAM add-in board that can expand the system to 16MB. Phoenix supplies the BIOS, which can be shadowed in both the system and the video modes. You can select a bus speed of 8, 10, or 12 MHz.

After the controller card, serial ports, and VGA adapter are installed, the remaining two 8-bit and three 16-bit slots offer plenty of room for expansion in a machine this small. But remember that to increase RAM you give up a 16-bit slot. The design would provide more expansion potential if it were possible to swap an 8-bit slot to get another 16-bit slot. Integrating the floppy/hard disk controller onto the motherboard would also increase expansion capability. As it stands, the 80386SX/16 teeters on the edge of not being expandable enough.

The latest crop of SX machines offers more performance and more hardware, at a lower price than ever before.

Externally, the machine looks pleasing to the eye with its neatly styled case. The power switch and indicator light flank the floppy disk drive bays on the right, while the indicators for the turbo and hard disk are grouped with the reset buttons, turbo switch, and lock on the left. At the base, a cooling grill runs the length of the case front. The high standard of finishing on the outside is indicative of the quality found on the inside.

Accessing the floppy disk drive bays requires some Houdini-like maneuvering, though. A bar that bisects the chassis and runs over the top of the drives from front to rear provides much-needed support to the case but proves difficult to remove. The half-height bay for the hard disk is mounted vertically, to the right of the floppy drives, ahead of the 150W HiGain power supply—resulting in a cramped fit. Otherwise, the inside of the machine appears to be well organized. All cabling is clipped neatly out of the way, and the internal arrangements, while tight, are orderly and easy to work on.

The $1,575 basic configuration of the 80386SX/16 comes with 1MB of RAM, a 1.2MB floppy disk drive, a monochrome card and monitor, and DOS 3.3 or 4.01. Our tested unit added another megabyte of RAM and an 80MB hard disk (one of only two models available from the manufacturer), and substituted a CTX VGA monitor. The price difference between the basic version and our $2,295 tested system is substantial, but outfitting the computer with the larger hard disk and VGA monitor makes for a much better bargain.

PSG's service provisions are typical for a machine in this price range: a two-year limited warranty that requires you to ship the unit back to the factory when it needs servicing. PSG currently does not offer an on-site service contract, but it's evaluating this possibility. The manual included with the machine is helpful but not outstanding.

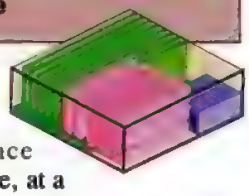
The price you wind up paying for the 80386SX/16's compactness is its limited expandability. The computer gives you room for only one additional half-height device with a hard disk and floppy disk drive installed, and if you want to exceed 2MB of RAM, one of the three 16-bit slots has to be sacrificed.

The machine's speed and its solid-quality components are its premier features. The PSG 80386SX/16 sits like a jewel on the desktop, but those who need room to grow may wind up looking elsewhere.

TENEX COMPUTER EXPRESS

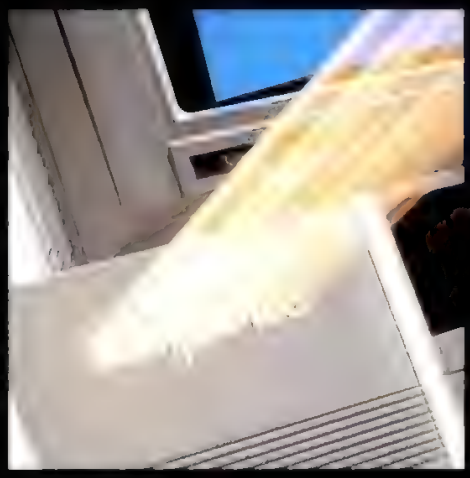
Tenex 386SX HD VGA System

by Fredric Burke



The latest crop of SX machines offers more performance and more hardware, at a lower price than ever before, and the Tenex 386SX HD VGA System exemplifies this trend. While the machine has some limitations, the $1,699 price tag for the standard configuration (or $859 for the basic configuration) makes the 386SX HD VGA System an alluring bargain.

Its well-proven hardware makes for attractive performance on some of our



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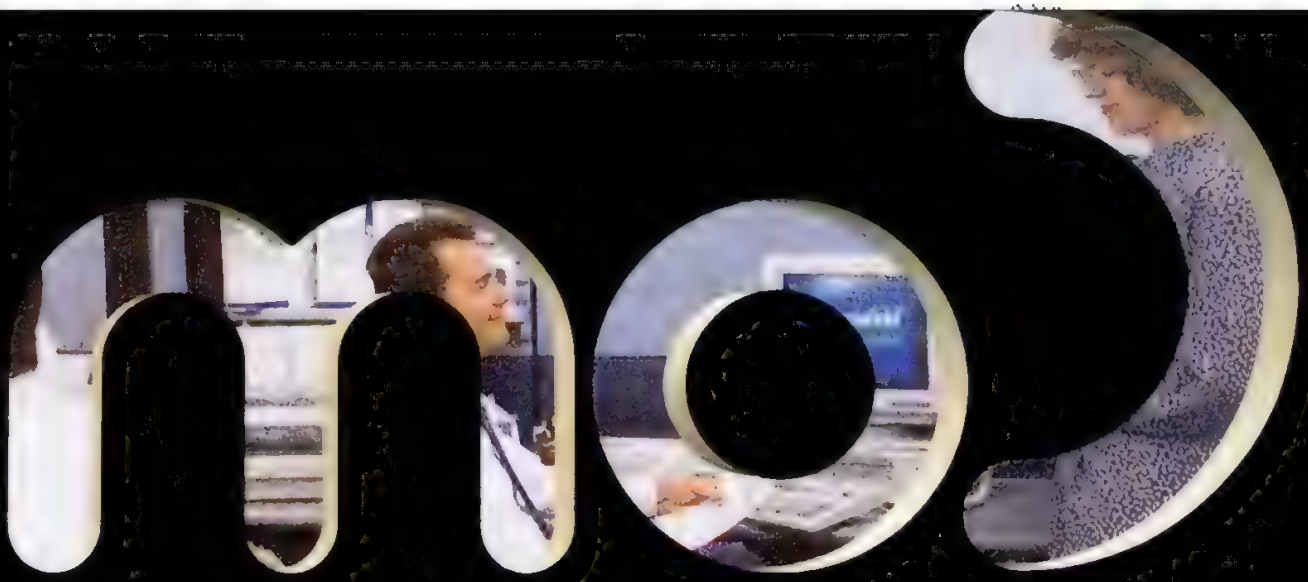

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IBM
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Compaq
10,040

CompuAdd
$4995

So what else could be behind the CompuAdd name?

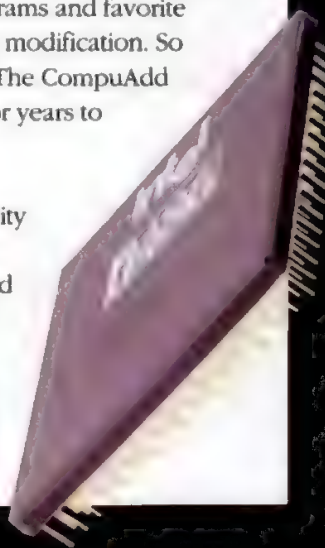
The most powerful chip on the market.

Surprise! We've been comparing the competition's 386-based machines to the state-of-the-art CompuAdd 425. Based on the revolutionary Intel 486 microprocessor — the "mainframe on a chip" — the CompuAdd 425 provides astonishing performance *at less than half the cost* of these 386s. And the value doesn't end there. You can continue to run all your old DOS programs and favorite 286/386 applications without modification. So why buy 386 obsolescence? The CompuAdd 425 will be *the* technology for years to come.

So what's behind the CompuAdd name? High-quality components, superior performance, affordability and leading-edge technology.

And what's in front of the CompuAdd name?

A lot of smiling faces.

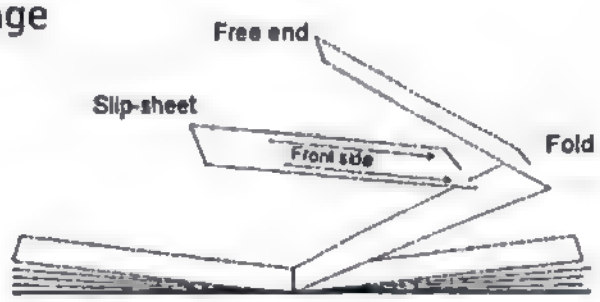


Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Folded edge of the page

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

GbsSlipBack-0018

Back

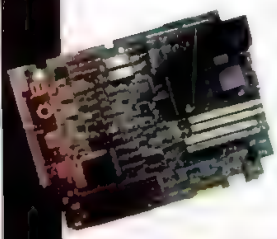
1. Follow instructions on the other side

Inverted Back

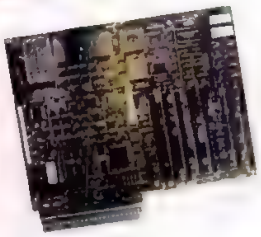
1. Follow instructions on the other side

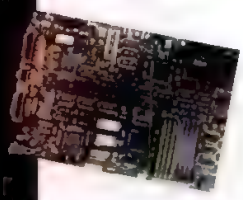
Is it the motherboard?

Look inside an IBM® PS/2 Model 70-386, a Compaq® Model 84-386 and a CompuAdd® system. See any visible differences? All three companies design and manufacture their own motherboards. They all use an Intel microprocessor and offer a number of available expansion slots (three on the IBM, six on the Compaq and five on the CompuAdd).



Each motherboard uses advanced surface-mount technology and top-quality components. Each manufacturer offers a choice of memory configurations, internal storage devices and a host of other options to create a flexible computing environment. And all three support DOS applications and VGA graphics modes.





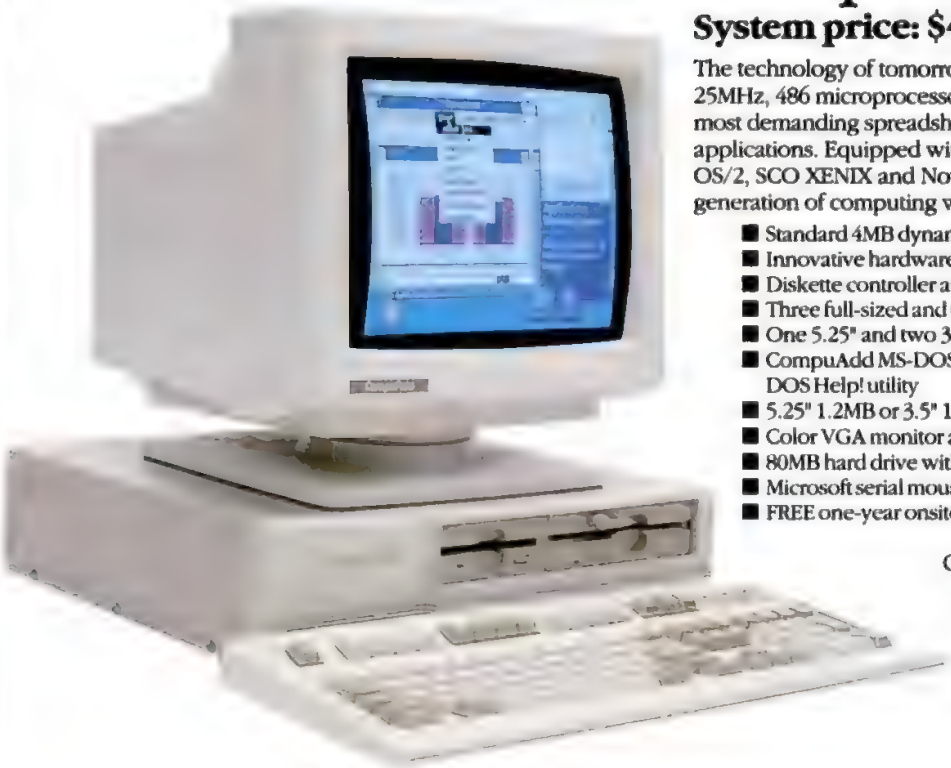
Is it performance?

We ran head-to-head benchmark tests* on these systems under three CPU-intensive applications: PageMaker, Magellan/1-2-3 and AutoCAD. While the results were no surprise to us, they might surprise you. Under PageMaker, CompuAdd performed 43% faster than IBM and 7% faster than Compaq. Running Magellan 1-2-3, CompuAdd was 46% faster than IBM and 26% faster than Compaq. And under power-hungry AutoCAD, CompuAdd outran IBM by 42% and edged Compaq by 8%.

(*Completion time in seconds)

CompuAdd 425

System price: $4995 *(66652)*



The technology of tomorrow is here! The CompuAdd 425 delivers 25MHz, 486 microprocessor computing to your desktop—power for the most demanding spreadsheet, database, network or CAD/CAM applications. Equipped with a Phoenix BIOS, the 425 offers full MS-DOS, OS/2, SCO XENIX and Novell compatibility. Step up to the next generation of computing with the CompuAdd 425!

- Standard 4MB dynamic RAM expandable to 16MB
- Innovative hardware ROM shadowing for increased system speed
- Diskette controller and hard drive interface on motherboard
- Three full-sized and two half-sized slots
- One 5.25" and two 3.5" half-height drive bays
- CompuAdd MS-DOS and Windows 3.0 software and DOS Help! utility
- 5.25" 1.2MB or 3.5" 1.44MB high-density diskette drive
- Color VGA monitor and 16-bit video graphics adapter
- 80MB hard drive with free PC-Fullbak backup utility software
- Microsoft serial mouse
- FREE one-year onsite service

CompuAdd 425 Enhanced Configuration

- Super high-resolution (1024x768) color VGA monitor
- CompuAdd 16-bit Hi-Rez VGA card
- 110MB hard drive
- **Enhanced system price: $5595** *(66654)*

CompuAdd 325

The full profile CompuAdd 325 flies at a speed of 25MHz, delivering 386 microprocessor power, 32-bit efficiency and superior engineering at bottom-line prices. *FREE! Windows 3.0 with hard drive option.*

- Standard 1MB dynamic RAM expandable to 16MB on motherboard
- High-speed cache memory controller with 32KB static RAM cache
- Color VGA monitor and 40MB hard drive
- 5.25" 1.2MB or 3.5" 1.44MB high-density diskette drive
- FREE one-year onsite service
- **System price: $2889** *(64842)*

CompuAdd 320s

Operating at 20MHz, the low profile CompuAdd 320s utilizes the 386SX microprocessor to perform 32- and 16-bit processing—at speeds that rival any 386-based machine. Save desktop space, but don't sacrifice power.

- Standard 1MB dynamic RAM expandable to 4MB on motherboard
- High-performance diskette controller and hard drive interface on motherboard
- 5.25" 1.2MB or 3.5" 1.44MB high-density diskette drive
- Color VGA monitor and video graphics adapter
- 40MB hard drive
- **System price: $2189** *(66542)*

CompuAdd Companion

The ultralight 4.4 pound Companion puts the performance of a full-sized 286 right in your briefcase! Completely AT-compatible, the sleek-gray Companion offers computing flexibility and performance on the run.

- 80C286 microprocessor running at 6, 8 or 12MHz
- Standard 1MB dynamic RAM expandable to 3MB on motherboard
- Compatible with MS-DOS, OS/2, SCO XENIX and Novell
- High-resolution, paper-white monographics VGA display
- 20MB hard disk drive with 23ms access time
- Compact dimensions of 8.5" x 11" x 1.4"
- **Base system price: $2895** *(62280)*

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benchmark tests. The machine did best on the processor tests and the small-record DOS File Access test. It lagged behind most of its competitors, however, on our video tests (especially Direct to Screen and Video BIOS Routine with Scrolling).

Inside the small-footprint box (6.5 by 17.5 by 16 inches), you'll find 2MB of 100-nanosecond SIP chips, a 65MB Seagate RLL hard disk, a 5.25-inch floppy disk drive, a Western Digital floppy/hard disk controller, a parallel port and two serial ports, and an Everex Max Logic VGA card. If you prefer, you can specify a 3.5-inch floppy disk drive; an additional drive costs $84.95 and is available in either a 740K or 1.44MB configuration.

Tenex also includes a handsome Samtron VGA monitor and Chicony's wonderfully clicky 101-key keyboard. Software is limited to a disk manager, the video setup, and LIM 4.0 EMS. To help keep the price at rock bottom, the company does not include DOS in its basic configuration. DOS 3.3 goes for $59.95, and 4.01 for $69.95. These are the only software options available with the machine. Hard disk options abound, from 20MB to 676MB.

The front panel is broken up by a small control panel housing the reset and turbo buttons, the lock, and the activity lights for power, hard disk, and turbo mode. The power switch is located safely out of reach, to the rear of the machine's right side. The attractively styled case occupies blessedly little space on your desktop.

Tenex 386SX HD VGA System
Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545; (800) 776-6781, (219) 259-7040
List Price: With 2MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, $859; with 65MB hard disk, VGA monitor, DOS 4.01, $1,699
In Short: Tenex packs above-average processor performance and a high level of standard equipment into its small-footprint machine.

CIRCLE 547 ON READER SERVICE CARD

> The Tenex 386SX HD VGA System is difficult to fault. Even at its base price it comes remarkably well equipped. You just add DOS and go.

The motherboard is built by DTK; Chips and Technologies supplies the NEAT chip set. The motherboard supports an Intel 80387-SX math coprocessor but not a Weitek; Tenex offers the Intel coprocessor for $349. The setup utility included with the DTK BIOS allows you to toggle between zero and one wait state. The bus speed remains fixed, however, at 8 MHz.

The basic configuration has 2MB of interleaved page-mode RAM, expandable to 5MB on the motherboard. RAM upgrades, available in 1-megabit chunks, cost $99.95 per megabit. Tenex offers an 8-bit Boca RAM AT card for $149; it does not yet have a 16-bit add-in board. This limitation is one of the most significant side effects of the low price.

Expandability poses no problem. Although the floppy/hard disk controller and video card occupy two 16-bit slots and an I/O card takes up an 8-bit slot, four 16-bit slots and an 8-bit slot remain available. The unit also includes two vertically mounted one-third-height drive bays and three half-height horizontal bays. Even though there is not much room inside, the area allotted for the slots is fairly generous, making it easy to swap cards in and out. To make this space available, Tenex packs the drive bays and the 200-watt power supply very tightly together.

Overall, the machine looks as if it can stand up to a lifetime of use. The chassis, though not as stiff as some, appears well built. A few minor design elements may be irritating. All of the cables are jammed into a chasm between the drive bays and the power supply, a space that measures some 2 inches wide and 6 inches deep. Trying to locate an individual cable in this space can be difficult.

Also, you need to exercise care when removing the cover. A spring-loaded clip at the top of the power supply is liable to catch the tangle of cables running from the controller card to the drives, and there is a distinct danger of accidentally pulling the cables from their sockets while removing the cover.

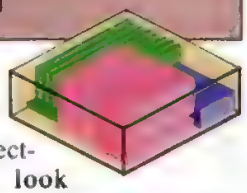
Tenex includes a two-year warranty that requires you to ship the machine back to the factory for servicing. For $49.95 extra, TRW provides on-site service during the warranty period.

In the final analysis, the Tenex 386SX HD VGA System is difficult to fault. Even at its base price it comes remarkably well equipped; all the user has to do is add DOS and go. Perhaps the greatest deficiency is that expansion is limited to 5MB, a barely adequate amount for today's applications. When Tenex rectifies this restriction, the machine will become an even better price/performance bargain.

TREASURE CHEST

Treasure Chest TC 386SX

by Bruce Brown



If price is your first consideration but you still want a respectable machine, look closely at the Treasure Chest TC 386SX. This small-footprint machine, which measures 6.5 by 17.25 by 16.5 inches, is a passable performer ready to battle the competition with an aggressive price—$1,659 in our standard configuration.

In fact, our tested unit cost a mere $1,599 and came with 2MB RAM, a 65MB Seagate 28-millisecond hard disk, 1.2MB Mitsumi floppy disk drive, 16-bit VGA display adapter, Emerson 14-inch color VGA monitor, one parallel and one

The Mitsuba 16 MHz 386SX

The 386-SX - with up to 5Mb RAM, a 40/104 hard drive, and IDE interface. Other specifications include: 2 serial ports, 1 parallel port, 1.2 or 1.44 floppy drive, a 101 key keyboard, and EMM driver.

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Mitsuba
A Name To Remember

CIRCLE 321 ON READER SERVICE CARD

serial port, 101-key Chicony keyboard, and DOS 3.3. Adding a second serial port would raise the price to $1,659, still a mouth-wateringly good deal.

The TC 386SX uses a Datatech Enterprises motherboard with a Chips and Technologies NEAT 386SX chip set. Datatech's DTK ROM BIOS is standard; a Phoenix ROM BIOS is a $15 option. The motherboard can house a maximum of 5MB RAM using both DIP chips and SIP memory modules. There's no provision for memory above 5MB. The system runs at either one or zero wait states, and it uses page-mode memory interleaving and video and system ROM BIOS shadowing.

The TC 386SX's case provides space for three half-height and two 3.5-inch storage devices. All five of the spaces can use removable storage media. However, the 200-watt power supply has only four power leads. If you load a system with the maximum number of drives, you will have to use a power splitter, either for two floppy disk drives or for a floppy and a tape drive. Neither of these combinations would call for power to both devices at the same time.

There are two 8-bit and six 16-bit expansion interface card slots, with five free slots available in our tested machine. All eight slots can take full-length cards.

The unit's benchmark tests scores vary. The processor and memory scores compare excellently with those of other 386SX machines. The other scores fall at or near the norm for these computers, with Video BIOS Routine scores on the slow side.

In one of the better deals we've encountered, Treasure Chest offers a one-year on-site service contract for $35.

You can expect respectable but not outstanding speed from this computer.

Treasure Chest sells computers by mail order and includes a one-year parts-and-labor warranty backed up by a toll-free technical support number. In one of the better deals we've encountered, the company will sell you a one-year on-site service contract from TRW for $35. The option is too inexpensive to pass up.

The Treasure Chest TC 386SX is a good machine, not extraordinary. There's nothing particularly noteworthy about it except that you can use five drives with open fronts in a machine with a fairly small footprint. The unit works well, the speed test results are satisfactory, and the price is right. ■

Treasure Chest TC 386SX
Treasure Chest, 4668 Portrait Ln., Plano, TX 75024; (800) 245-3040, (214) 233-2880.
List Price: With 1MB RAM, 1.2MB 5.25-inch floppy disk drive, $699; with 2MB RAM, 65MB hard disk, VGA monitor, one parallel and one serial port, DOS 3.3, $1,599; with two serial ports, $1,659.
In Short: The Treasure Chest TC 386SX is a low-priced, small-footprint machine with passable overall performance. If you buy one, be sure to get the $35 option for one-year on-site service.

CIRCLE 548 ON READER SERVICE CARD

Bruce Brown *is a contributing editor of* PC Magazine *and a computer consultant based in Simsbury, Connecticut.* **Fredric Burke** *is a free-lance writer and an associate production editor at Raven Press, a medical and life sciences publisher.* **Rink Murray** *is an assistant editor at* PC Magazine. **Bill O'Brien** *is a contributing editor of* PC Magazine. **Ed Perratore,** *a frequent contributor, is a former associate editor of* PC Magazine. **Alfred Poor** *is a contributing editor of* PC Magazine *and an industry analyst based in Perkasie, Pennsylvania.*

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3. **Top-tier Performance.** With its high-speed memory cache and Landmark** rating of 23.1, the Premium 386SX is faster than other name-brand SX machines on the market. It's even faster than our Bravo/386SX. If you're interested in speed, this is the machine for you.

4. **An Award-Winning System.** The Premium 386SX is one of the most highly praised computers today. It won PC Magazine's Editor's Choice award. It outranked Compaq's SX in an InfoWorld report. It even garnered praise from the German Publication, Persönnel Computerlich, as the "Very Best" SX computer.

5. **Rich With Features.** Standard VGA graphics; a wealth of drive bays and expansion slots; support for up to three floppy drives; password security and one parallel and two serial ports.

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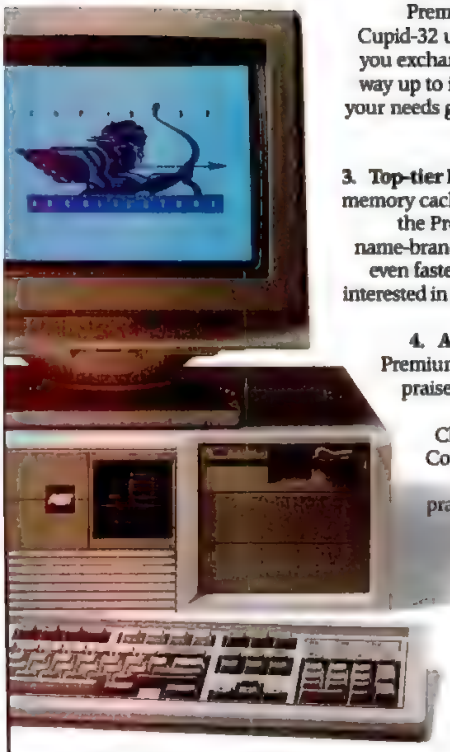

AST Premium 386SX
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1. **Entry-level Price.** The Bravo/386SX is one of the most cost-effective desktop computers you can buy. Starting at $2095,* you can get 32-bit functionality for the price of a less-powerful 80286 system.

2. **Surprisingly High Performance.** A lot of companies can build an inexpensive SX computer, but AST goes one step further. Bravo/386SX is faster than SX computers from Compaq,® IBM,® Epson® and NEC.®

3. **A Very Small Footprint.** Our engineers packed a lot of power into this small-footprint computer. Which makes it perfect as a desktop-saving network node. But, there's still plenty of room for expansion boards and drives.

4. **No Extra Cost For Extra Features.** Bravo/386SX comes standard with the features you need. Bright VGA graphics and 2 MB of fast paged-mode RAM don't cost you extra, but they sure put an extra level of power at your fingertips.

5. **Integration And Design Spell Quality.** Bravo/386SX's clean design is not only attractive, but it's based on the kind of ergonomics that makes it easy to upgrade and service. And Bravo is one of the most reliable computers in the industry.

6. **Lots Of Company.** In a recent survey,*** the Bravo/386SX came out as one of the ten best-selling desktop computers in the nation. People everywhere are finding a lot to applaud about for Bravo.

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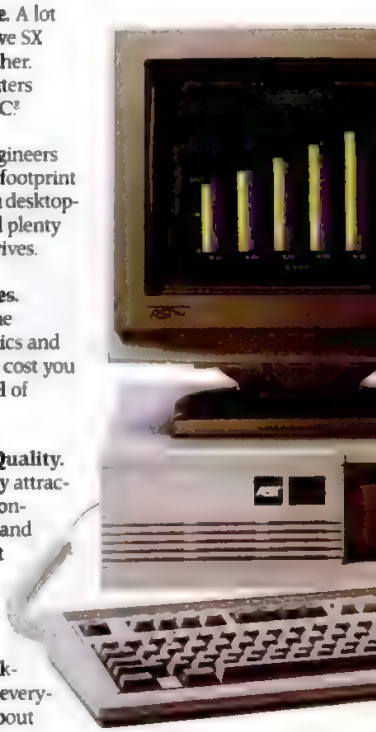

AST Bravo/386SX.
Starting at **$2095.**

*List prices are MSRP — 4/1/90. **Speed tests based upon Landmark Software version 1.10 benchmarks — a generalized index used to compare machines. The higher the number the better. ***Computer Reseller News, March 26, 1990. Source — Storeboard, Inc. AST markets products worldwide — Corporate Headquarters: P.O. Box 19658, Irvine, CA 92713-9658 (714) 727-9292, in Europe and the Middle East call 44 1 568 4350; in Japan call 81 3 818 0710; in the Far East call our Hong Kong office at 852 5 806 4333; in Canada call 416-826-7514; in Australia call 61 2 906 2200. AST is a supplier to U.S. government agencies, General Service Contract number GS00K89AGS6418. AST, AST logo and AST Premium registered and Cupid-32 and Cupid logo trademarks AST Research, Inc. All other product or brand names are trademarks or registered trademarks of their respective companies. Copyright 1990 AST Research, Inc. All rights reserved.

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PC MAGAZINE EDITOR'S CHOICE
March 14, 1989

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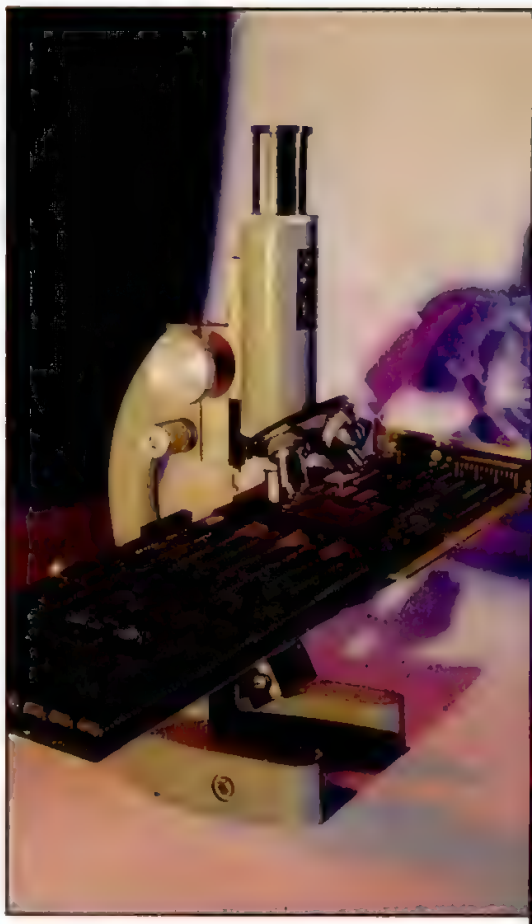
CIRCLE 103 ON READER SERVICE CARD

PINPOINTING RAM AILMENTS:

Memory Diagnostic Software

by Bill O'Brien



PHOTOGRAPH: JOHN WILKES

The most often-quoted line concerning computer reliability is that if it works for the first hour you own it, it will work forever. Unfortunately, that's not quite true. Nothing lasts forever, least of all the myriad of interfunctioning components inside a PC.

Luckily, certain maladies are obvious. An asthmatic whine emanating from the depths of your hard disk and the frequent need to run CHKDSK are dead giveaways that you're on the brink of data Armageddon. A persistent "brraaakk" as your floppy drive tries to back its read/write head out of the rear of the case is another warning of trouble ahead. These are physical manifestations of problematic conditions with *mechanical* devices. Even your computer's video system, a mixture of the invisible machinations of electronics and the display board and monitor, produces obvious symptoms that let you make definite decisions as to the cause and cure of the problem.

But at the chip level, where information passes back and forth in the form of encoded pulses traveling at nanosecond rates, nothing is that obvious. When a problem occurs, the effect can be painfully visible even though the cause is buried beneath layers of silicon and plastic. While there are a host of electronic support chips on a motherboard, including those that handle addressing, interrupts, and management chores, the responsibility for the majority of irritating glitches and system halts often falls on the lowly RAM chip.

Memory diagnostic utilities like *AMIDIAG, CheckIt, DR-Chips, QAPlus,* and *Service Diagnostics: The Kit* don't just tell you how your RAM is arranged; they tell you where the problem lies when something goes wrong with your PC's memory.

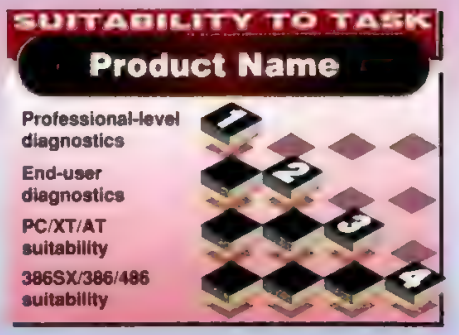
There are three basic types of RAM problems. The first is the catastrophic fault, announced by the ominous appearance of a MEM ERR message and the stubborn refusal of your system to proceed any further than that step in the power-on self test (POST). The second is a device-fault-related error: the POST returns a memory error message but lets you continue on and boot the machine. Finally—and this is the most elusive and frustrating problem—for no apparent reason, with no specific relationship to the application you're running, your system freezes or reboots itself. The POST reports no problem, but nonetheless the freezing or rebooting persists at maliciously random intervals.

boards, disk drives, and socketed chips (RAM and otherwise) goes a long way toward increasing productivity by getting an organization's machines back in action in a short time.

Since RAM chips are often the culprit in machine glitches, this review focuses on five products that perform memory diagnostic services: Alpha Group Operation's *DR-Chips*, American Megatrend's *AMIDIAG*, DiagSoft's *QAPlus*, SuperSoft's *Service Diagnostics: The Kit*, and Touchstone Software's *Check-It*. It is worthwhile to note that, with the exception of *DR-Chips*, all these utilities also offer other diagnostic capabilities. While

SUITABILITY TO TASK

PC Magazine has assessed these five memory diagnostic packages' suitability in four arenas—for professional or technical support use, for end users, for use on PC/XT/AT-class machines, and for use on 386SX/386/486-class machines—and has assigned a point value for each one. These subjective ratings, on a scale from zero to four, are presented along with each review, and they translate as follows: 0—Lacks feature or not at all suited; 1—Poorly suited; 2—Some capability; 3—Well-suited; 4—Ideal for the task.



The time-honored method of correcting either catastrophic or device-fault memory errors has been to send them out to the proverbial shop. There, technicians methodically replace successive chips, or preferably banks of chips, until the problem disappears (as for the randomly glitching PC, it usually proves resistant to most repair efforts). Traditional as that approach may be, the current cost of memory devices and the price of labor for such a time-intensive task means that it is no longer a viable first-choice solution.

THE NEED FOR DIAGNOSTICS

Today, in a world where large corporate organizations often own more PCs than the total number of systems sold in 1980, some method of performing accurate on-site diagnostics has become mandatory. While some equipment is still subject to repairs that require a trip to the shop, most companies maintain their own first level of in-house technical support. On-the-spot diagnosis of problems that occur in easily replaceable components such as

system information packages like Ashton-Tate's *Control Room*, Quarterdeck's *Manifest*, Dariana Technology Group's *System Sleuth*, and Sofwin's *RAMWin* duplicate many of the functions of the five evaulated here, their diagnostic procedures do not extend to random access memory. *PC Magazine* will review system reporting packages like these later this year.

Our tests—conducted on a Compaq Deskpro 386, an Arche 386, and an IBM AT—produced some surprises. We found that when it comes to memory, certain things are sacrosanct. None of the packages, for example, provided a specific selection for processor RAM caches, and therefore all were unable to diagnose a processor RAM cache error on the Compaq system.

Additionally, most of the packages seem designed to deal only with more-conventional XT/AT RAM arrangements in which two to four rows of DIPs contain the entire system memory. Confused by 80386 system RAM arrangements sport-

EDITOR'S CHOICE

- **AMIDIAG**
- **Service Diagnostics: The Kit**

All of the packages we reviewed had a defined level of performance and a specific audience, but two stand out from the rest. American Megatrends' *AMIDIAG* is the most comprehensive package that delivered the most-accurate results in the shortest time. Its $89.95 price tag puts it well within the reach of almost anyone who owns a computer.

At the other end of the spectrum, SuperSoft's *Service Diagnostics: The Kit* is a technician's dream, with all of the tools necessary to accurately analyze all phases of computer operations, even when the machine won't boot on its own. The $495 price for the basic kit is well worth its performance potential.

ing multimegabytes of 1MB SIMMs, most were hard-pressed to accommodate the eight banks of 1MB SIMMs in the Arche machine. On that system, only *AMIDIAG* and *Service Diagnostics* demonstrated a 1-to-1 correspondence between what was actually on the motherboard and what was displayed on-screen. Multiple SIMM banks won't be the only devices to cause problems for many of these products—systems with mixed DIPs and SIMMs will be equally trying to their capacities. Strides are being made in this area, though: new versions of *DR-Chips* and *QAPlus* (both set for summer release) will encompass the SIMM/DIP environments of 80386 machines, and *DR-Chips* will also address some 80486 diagnostic areas.

Most of the current versions of these products will do a fine job for the many XTs and ATs that still form the bulk of many organizations' installed base of machines. But for now, *AMIDIAG* and *Service Diagnostics* are the only packages that go one step beyond to offer the more-sophisticated diagnostics demanded by organizations stocked with 386 machines. Regardless of the category your company falls into, it's a wise choice to invest in memory diagnostic software: these packages are sure to save you the time and the expense of a trip to the repair shop.

AMIDIAG

You might expect the creator of BIOS ROMs for a wide variety of computers to know how to write diagnostic programs. In the case of American Megatrends' *AMIDIAG*, your expectations would certainly be met. *AMIDIAG* is a professional-quality product selling at the strictly amateur price of $89.95.

AMIDIAG has made no attempt at impressive packaging: the software arrived in a small, plastic zip-lock bag packed with 150 pages of unbound, three-hole-punched, tablet-sized documentation. The manual is typeset and subdivided to accommodate the multitude of tests available: RAM, system board, hard and floppy disk drive, video, keyboard, and I/O ports. The manual calls for your system to be equipped with DOS 3.0 or later, but the software came on a bootable system disk.

SUITABILITY TO TASK

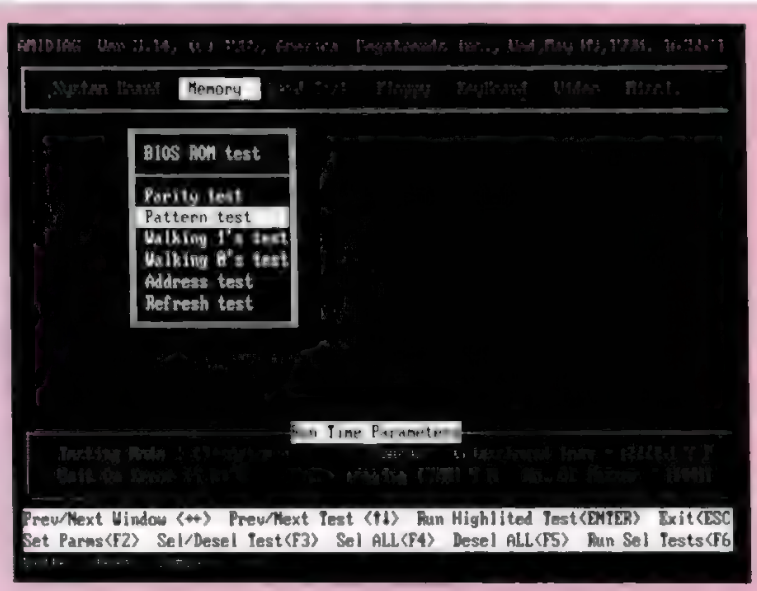
AMIDIAG

Professional-level diagnostics	3
End-user diagnostics	4
PC/XT/AT suitability	3
386SX/386/486 suitability	3

In fact, although the software can be called from the DOS command line, a clean boot is the preferred method of running *AMIDIAG*. As with all the packages we reviewed, the product requires that no resident programs be loaded in memory when the diagnostics are run—that includes TSRs and software drivers (hard disk, EMM).

AMIDIAG's opening screen requires you to create a log entry for the machine you're about to test. As each entry is made, it's stored on disk and appears as a selectable option the next time you load the software. This is an excellent idea that allows you to maintain a stable of equipment without the need to reenter parameters each time you run the diagnostics.

When you're entering a new machine, *AMIDIAG* will read the memory size from CMOS; you have the option of accepting its report or changing the amount to account for incorrect CMOS information. If you alter the setup later, you can also change the information contained in the existing log entry. By specifying the RAM type and size, you configure the visual representation of the RAM banks that appear if an error is found. *AMIDIAG* presents the most accurate visual representation of any packages reviewed, but placement of the parity bit with regard to the data-bit labeling on an IBM AT appears to be reversed. Parity-error reports are accurate, however; when an error is displayed just ignore the screen and refer to the correct chip as labeled on the motherboard.



Unlike *CheckIt* and *DR-Chips*, *AMIDIAG* offers no informational displays from its pull-down menus. All the options lead directly to tests.

While it hasn't actually tackled windowing, *AMIDIAG* has structured its diagnostics to operate from pull-down menus, with each menu designed to reflect a separate suite of tests. Six memory tests are available, but the manual comes up short in describing them. The Pattern Test, for example, is described as an elaborate read/write test that will identify most memory faults. The validity of the description is not in question, but *AMIDIAG* could certainly amplify it to explain when the test is most appropriate, as it is the longest running in the series even when defaulted to a single pass. You wouldn't, for example, turn to it if you were confronted with a constantly recurring problem, like the POST reporting a memory error—in that instance, the Walking 1's and Walking 0's tests are quite capable and much faster.

The Pattern Test is more appropriate for a randomly glitching system with no real hard errors reported by the built-in POSTs. In such a case, you'd most likely run the test for a prolonged period of time by resetting the running parameters. You can restate the time length, a pass length for the number of iterations the test should perform, or simply make it a continuous test.

Accuracy is not an issue for *AMIDIAG*. As with all of the software we evaluated, it would not function under an EMM expanded-memory driver, but it was capable of finding the errors in six of the remaining seven tests. It missed only the potentially problematic situation of mixed 150-nanosecond and 120-ns. chips on a bus-mounted extended-memory card in an 8-MHz IBM AT. However, running the pattern test for a prolonged period of time (we ran it 21 minutes) would proba-

FACT FILE

EDITOR'S CHOICE

***AMIDIAG*, Version 3.14**
American Megatrends Inc., 1346 Oakbrook Dr., #120, Norcross, GA 30093; (800) U-BUY-AMI.
List Price: $89.95.
Requires: 512K RAM, one floppy disk drive, DOS 3.0 or later.
In Short: *AMIDIAG* is priced for the individual but will work in a small support system if needed. It's simple to use, appears to be extremely accurate, and should be added to your "must have" list of software.

CIRCLE 411 ON READER SERVICE CARD

bly have reported that error as well.

An appealingly low price, accuracy, and simplicity make *AMIDIAG* the most desirable of the five packages in a moderately demanding diagnositic environment.

CheckIt

A feature-packed diagnostic tool, Touchstone Software's *CheckIt* is quite capable of handling a range of computer difficulties. But when it comes to 80386 technology, this $149 package still has some rough edges.

CheckIt doesn't have any special booting procedures other than not loading memory resident software while using the program. *CheckIt* is not copy protected, but the opening screen requires you to enter your name and organization the first time you use it; it's a small annoyance that you can't leave the information blank without the software dumping you back to the operating system.

CheckIt uses a windowing system of menus and the amount of information available is commendable. You can view everything from general configuration information to IRQs and even the contents of your CMOS. A small benchmark test section gives you a reasonable comparison of your system's performance with a few of the more popular computers currently available.

The program asks you to supply the information needed to create an accurate RAM map of your system, including motherboard and add-in memory. Owners of 8- or 16-bit computers will have no problem following the procedure, but if you own a 32-bit system, you may become confused. Set for a 32-bit word, *CheckIt* stubbornly refused to agree that there was only 8MB of memory in the 16MB Arche 386/33 test machine. A quick call to Touchstone Software revealed that the company knows about this 32-bit problem; an upgrade should be available by the time you read this. In the interim, Touchstone suggests that the word length be reset to 8 bits for the proper memory contents to be displayed. The solution worked, but I had greater expectations of software priced at almost $150.

SUITABILITY TO TASK

CheckIt

Professional-level diagnostics	2
End-user diagnostics	3
PC/XT/AT suitability	3
386SX/386/486 suitability	3

The RAM diagnostics are comprehensive. *CheckIt* refused to work with an expanded memory manager in place (as did all the packages we reviewed), but it correctly interpreted error results from three of the remaining seven tests. At the quick-test level, it couldn't detect the mismatched chip speeds, but it's always possible that no error occurred during the interval in which the test was run. If the test had been prolonged for an hour to give the error more of an opportunity to appear, it's likely that the program would have caught it.

Two real problems did arise with the software during the testing, though. When run on the Arche with seven banks of 1MB SIMMs and one bank of 256K SIMMs, the computer's CMOS only recognized the first 4MB of memory. *CheckIt*

MEMORY DIAGNOSTIC UTILITIES: SUMMARY OF FEATURES

Products listed in ascending price order

	DR-Chips $29.95	AMIDIAG $89.95	QAPlus $139.95	CheckIt $149.00	Service Diagnostics: The Kit $495.00
Processor support:					
8086/8088	■	❑	■	■	■
80286	■	■	■	■	■
80386/80486	❑	■	■	■	■
Shows memory map that includes:					
Base memory	■	■	■	■	■
Back-filled memory	■	■	■	■	■
Expanded memory	❑	❑	■	■	■
High memory	■	■	■	❑	■
Reserved memory	■	■	■	❑	■
Shadow RAM	❑	❑	■	❑	❑
Expanded-memory handling:					
Detects version	❑	❑	❑	❑	❑
Detects manufacturer	❑	❑	❑	❑	❑
Detects page size	❑	❑	❑	❑	❑
Measures RAM wait states	❑	❑	❑	❑	❑
Measures RAM speed	❑	❑	❑	❑	❑
Distinguishes between system and board RAM on 8086/80286	❑	❑	❑	❑	❑
Cache-memory handling:					
Tests processor cache	❑	❑	❑	❑	❑
Tests controller cache	❑	❑	❑	❑	❑
Lists CMOS memory information	❑	❑	■	■	■
Works with protected-mode EMM	❑	❑	❑	■	■

☆—Editor's Choice ■—Yes ❑—No

Base memory is the RAM area from zero to 640K.

Back-filled memory. Older PCs originally came with 512K RAM on the motherboard. Memory added through third-party boards to bring the total amount of memory to 640K is called back-filled memory.

Expanded memory is bank-switched memory above 1MB.

High memory is the area that DOS sees above 640K and below 1MB.

Reserved memory is the memory between 640K and 1MB where the BIOS and video adapter information is stored.

Shadow RAM is 32-bit memory in 386 machines into which BIOS routines are directly loaded on boot-up. Like a cache, the relocation speeds up system performance, but there is the loss of 384K of high memory.

Cache memory acts as a queue between a fast I/O device or CPU and the slower main memory in a 386 machine. Processor cache RAM is typically a small bundle of fast static RAM.

CMOS memory is used for storing system configuration information, as well as the time and date.

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"The icon-oriented NewWave 'office' resembles the Macintosh Finder but is much more capable."*
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"NewWave provides the best environment available today for combining traditional DOS applications with object-oriented principles."
—Datapro

"Recognized by over 600 members of the Software Publisher's Association for Best Design Achievement and Best Business Application in 1989."
—Software Publisher's Association

"NewWave Write comes with a few bonus features that the other products don't have—for instance, it 'remembers' from the previous session which documents are still being worked on, and opens them automatically."
—PC Week

"...NewWave is a splendid example of the kind of software innovation that is revolutionizing PC use."
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"You've heard it before, but this time it's for real. This is the year of the object. Hewlett-Packard's NewWave is going to be the forerunner for a lot of exciting things for the 1990s."
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"The appearance and functionality of the NewWave environment replicate the legendary Macintosh ease of use to a greater degree than any other PC graphical user interface to date."
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"Definitely the shape of things to come."
—Practical Computing

"Hewlett-Packard's NewWave is built on top of Microsoft Windows, and it bears a strong resemblance to the Macintosh desktop. It redefines how people should use software and how developers should build it."
—PC/Computing

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"Hewlett-Packard's NewWave is an exceptional advance in user interface design, rendering PC software dramatically more capable and simple to use. It also beats the pants off of the disappointing OS/2."*
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—PC Week

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"NewWave's object management facility is its most powerful feature. The system treats a data file and the application that manipulates it as a single object. This enables users to invoke one application within another...NewWave's object management also lets users create hot links between objects to share and dynamically update data."
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"HP provides several levels of integration for DOS applications in the NewWave environment, ranging from running under the iconic desktop and swapping data via the Clipboard, to full compatibility."
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FACT FILE

***CheckIt*, Version 2.1**
Touchstone Software Corp., 909 Electric Ave., Seal Beach, CA 90704; (800) 531-0450, (213) 598-7746.
List Price: $149.
Requires: 384K RAM, one floppy disk drive, DOS 2.0 or later.
In Short: The bulk of *CheckIt* is dedicated to system information and control, and even with the few quirks in its RAM diagnostics, the *CheckIt* program is a handy tool to have around.

CIRCLE 412 ON READER SERVICE CARD

pulled the memory size from CMOS, and consequently, incorrectly identified the installed amount. To its credit, the software allows you to alter the memory size through a pull-down menu for such occasions. When changing the values, however, weird things occasionally happened. For instance, when attempting to change the memory value in the fifth bank from zero to 1MB, the value of the sixth bank would actually change while that of the fifth bank would remain the same. (Obviously, this does not inspire confidence.) *CheckIt* was unable to locate the bad bank of SIMMs during this test.

The second problem is that *CheckIt* reports memory errors by their address. You must jot the address down on paper (or your arm or whatever's available) and then go to the menu function that pinpoints the bad RAM on *CheckIt*'s chip map based on the address you'll have to enter. It's an unnecessary two-step procedure and, for the price, *CheckIt* should be doing the work.

Assuming that the new version "rights the wrongs" found in the current release, 80386 owners will delight in the wide range of information and extensive testing available from *CheckIt*. As it stands now, though, only 8086, 80286, and 80386SX users will find it more than satisfactory.

DR-Chips

Shipped without printed documentation and including just a single disk in the packaging, *DR-Chips* does not lend itself to being taken seriously at first sight. The least expensive of all the packages reviewed, Alpha Group Operation's $29.95 product is strictly a memory-diagnostic utility. No compromises have been made to include BIOS searches, disk handling, or examinations of anything except your system's RAM, but as you'll find out if you consult it, the *DR* can be quite a knowledgeable specialist.

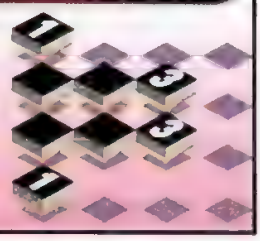
You must boot your machine using the program disk (your choice of a 5.25- or 3.5-inch floppy disk), assuring that no other software will interfere with *DR-Chips*' operation. Although *DR-Chips* will run on an 80386-based system, 1MB SIMMs are not its standard fare. Our 32-bit, 33-MHz 80386 Arche machine, stuffed with 8MB of memory in such SIMM packaging, totally confused it. *DR-Chips* assumed that the machine utilized 256K chips, and even then displayed only four banks. Changing the word length from 32-bit to 8-bit (which can only be done from the opening screen) does improve the one-to-one correspondence between the displayed map and your actual system layout, but it's still never exact. A representative of Alpha Group says the company is aware of the problem and a new version should be ready by the time you read this.

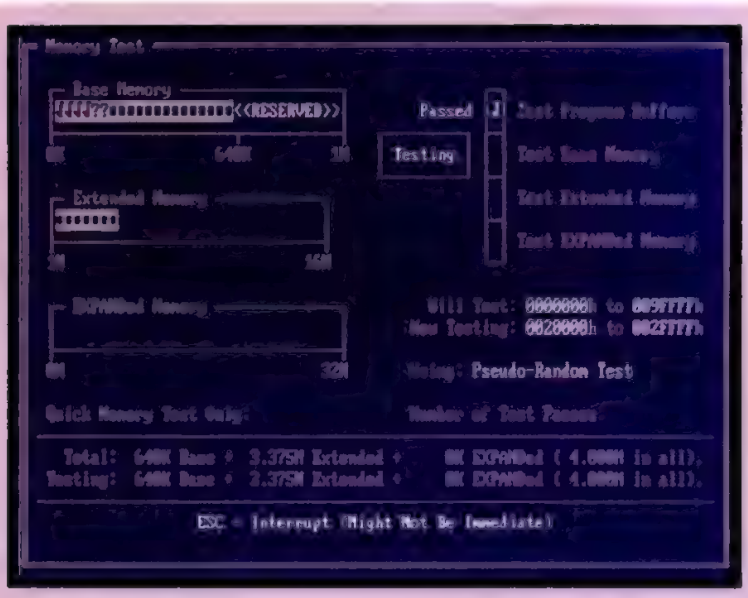
The confusion *DR-Chips* experienced over the SIMMs didn't do much to erase the poor first impression it had made. Running our benchmark tests made things even worse—the program failed every one of them on each machine, even when the computer being tested spotted an error with its own POST. *DR-Chips* uses a complex algorithm composed of a combination of various industry-standard memory tests. To correctly execute them (even at the default Novice level with only four of the 26 possible test varieties included), the documentation suggests that you start the program as you're leaving for lunch and then have a good one. I was manually terminating the tests after 30 or 40 minutes, the longest time taken by any of the programs to complete their functions.

Just for fun, I booted *DR-Chips* into the Arche machine and let it run overnight. Sure enough, the next morning there was a list of memory errors, but that wasn't all. The package had caught the bank of SIMMs (roughly, at least, according to the display), and it had also flagged some of the chips as weak and potentially problematic. Since the Arche had been chosen

SUITABILITY TO TASK

DR-Chips





On this *CheckIt* screen, check marks indicate good RAM and question marks indicate testing in progress. *CheckIt* will test memory that's expanded even when no expanded-memory drivers should be present.

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DR-Chips
Alpha Group Operation,
3953 Glenn Meadow Dr.,
Norcross, GA 30092; (404)
448-2828
List Price: $29.95.
Requires: 64K RAM, one floppy disk drive. Self booting, no DOS required.
In Short: *DR-Chips* is a low-cost alternative to higher-priced system diagnostics. It tests only RAM and is best used on an individual basis for quality assurance.

CIRCLE 413 ON READER SERVICE CARD

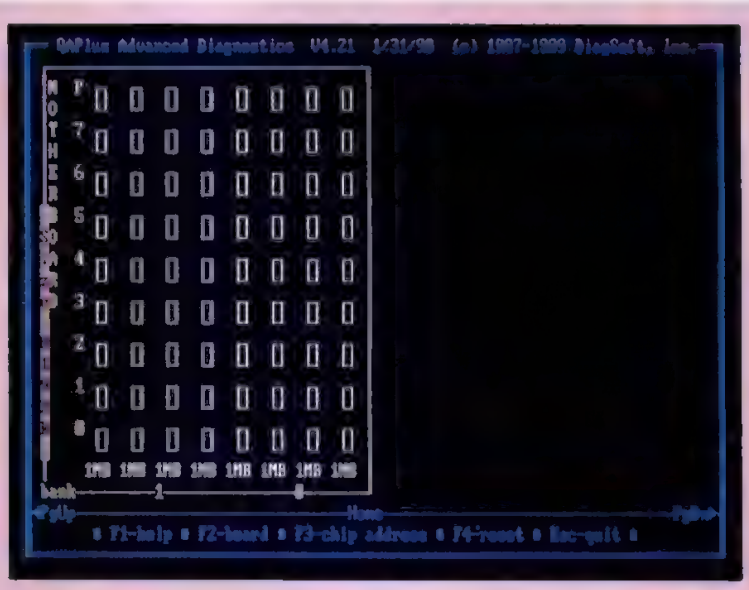
for its unknown glitching problem, *DR-Chips*' catch of the weak chips was quite an accomplishment. While the other packages evaluated here discerned the bad bank, none of them suggested that other problematic chips might exist (in all fairness, they were not run as long as *DR-Chips*, either).

There is no way to honestly recommend *DR-Chips* to a service bureau or for use in any situation that requires rapid diagnoses of hard-error conditions. Fortunately for Alpha Group, there are enough individual users who can afford the miniscule price of the package and will happily donate a few hours to diagnose the problems behind their systems' mysterious glitches. That's the niche for *DR-Chips*.

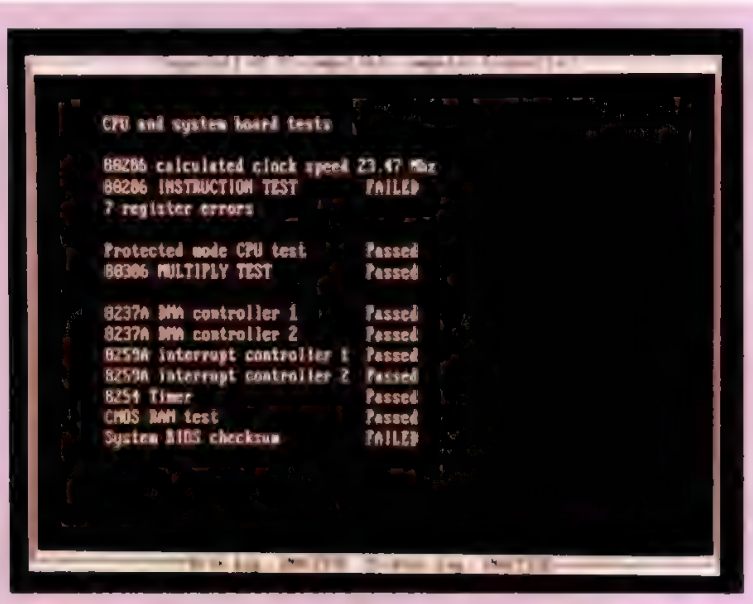
QAPlus

DiagSoft's *QAPlus* is reminiscent of *CheckIt* in design and general performance. A call to DiagSoft confirmed that both programs share common ancestral source code from which they have since diverged. The two also differ a bit in cost—at $139, it's $10 less than *CheckIt*.

QAPlus is not copy protected and can be run from the system prompt (it requires DOS, Version 2.0, or later). There are, of course, the standard warnings about not using other memory resident programs while running *QAPlus*. It uses a windowing environment, complete with pull-down menus that let you access nearly all your system information; you can view anything from the general configuration of your computer to the contents of CMOS memory and IRQ assignments. However, I experienced a problem related to this last display, in which interrupt 7 was alternately identified correctly for LPT1 and then incorrectly for COM2 (which was actually interrupt 3). Like *CheckIt*, *QAPlus* also contains a small benchmark test program, which you can use to compare your system's performance to that of other machines, including IBM and Compaq models.



QAPlus's memory map is as accurate as any of the nonprofessional-level packages, even though the diagram depicts chip banks, not SIMMs.



This is *DR-Chips*' only testing screen. The test procedures it employs can be run in fast or slow mode and will run forever to discover intermittent errors if you let them.

DiagSoft has done some nice work with *QAPlus*'s memory reporting. Like *CheckIt*, you'll need to configure your own memory map to indicate the correct number of RAM banks and the position of the chips, but *QAPlus* understands the concept of a 1MB chip and 80386 architecture. It correctly compiled eight 32-bit rows to form the Arche 386's 8MB of memory. When it comes to older machines, you can define carded memory in similar fashion, and no matter what com-

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FACT FILE

***QAPlus*, Version 4.21**
DiagSoft Inc., 5615 Scotts Valley Dr., #140, Scotts Valley, CA 95066; (408) 438-8247.
List Price: $139.
Requires: 512K RAM, one floppy disk drive, DOS 2.0 or later.
In Short: RAM diagnostics are just a small part of *QAPlus*'s total package, and its price tag makes it most desirable as an overall system assurance and information package.

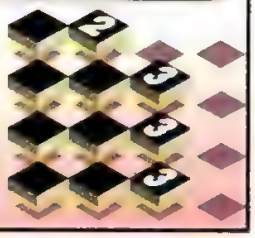
CIRCLE **414** ON READER SERVICE CARD

puter you're using, you may edit the configuration at any time. *QAPlus* saves the last configuration definition.

Running the memory diagnostics takes about 40 minutes on an 8-MHz IBM AT with 4MB of memory installed, and 25 minutes on the Arche system. Memory errors are displayed as addresses, and as with *CheckIt*, you must take the extra step of entering the address into a separate section of the program to find the actual location of the chip. Given the price of the software, this extra step should not be a manual procedure—*QAPlus* should be smart enough to recognize the address and then cross-match it to the correct chip location.

SUITABILITY TO TASK

QAPlus



PERFORMANCE TESTS: MEMORY DIAGNOSTIC UTILITIES

We found that all the memory diagnostic packages are still geared toward testing AT-class systems. 386-based machines are more difficult to diagnose because the memory architecture is more flexible, and there are more memory arrangements the manufacturer can choose to implement.

Overall, the $495 *Service Diagnostics: The Kit* was the best performer. It's the only package that includes its own ROM boot-up chip. Nevertheless, *AMIDIAG* ($89.95) performed nearly as well and was the only package that succeeded in detecting a flawed memory chip in the 386 machine. Only *AMIDIAG* and *Service Diagnostics* were able to detect the replacement of a 1MB RAM chip with a 256K chip in the Extended-Memory SIMM Size test.

These pass/fail performance tests assess the ability of memory diagnostic software to find and explain common memory problems. We replicated the most common memory problems that these packages are asked to diagnose. The tests were first run in the diagnostic software's simplest operating level with one iteration. If the software did not detect a problem, it was configured to run its most comprehensive set of test patterns for three iterations.

These tests focus on the actual physical memory of a system. The packages assume that CMOS is properly configured and that all DIP switches for memory setup are properly set.

We ran the tests with the following hardware (some of which included intentionally malfunctioning memory):

- An IBM AT with 512K on the motherboard and base memory intact.
- A Compaq Deskpro 386/25 with 640K and a 64K processor cache.
- An Arche 386/33 with 8MB of interleaved memory and a parity error in extended memory in the fourth 1MB SIMM.
- A fully functional Intel daughterboard (A) with 2MB of memory.
- An Intel 2MB daughterboard (B) with a 150-nanosecond 256K DIP chip within a 120-ns. bank.
- An Intel 2MB memory piggyback board (A) with a bent pin on a 150-ns. 256K DIP parity chip.
- An Intel 2MB memory piggyback board (B) with a "hard error" (a consistently occurring error) in a DIP chip.
- An Intel 2MB memory piggyback board (C) with a "soft error" (an intermittent error) in a DIP chip.

The **Extended-Memory SIMM** test detects the diagnostic software's ability to analyze SIMM memory in an interleaved-memory configuration. We ran this test on the Arche 386/33.

The **Extended-Memory DIP Speed** test searches for a 150-ns. DIP that was placed in a 120-ns. bank on the Intel daughterboard B.

The **Extended-Memory DIP (consistent errors)** test determines whether the software can detect a defective chip that produces consistent errors in a bank of extended memory. We used the Intel daughterboard A (with piggyback board B attached) in the IBM AT for this test.

The **Extended-Memory DIP (intermittent errors)** test determines the software's ability to detect a slightly less defective chip (which creates only intermittent errors). We used the Intel daughterboard A in conjunction with piggyback board C for this test.

The **Extended-Memory DIP (bent pin)** test is used to detect a purposely disabled pin on a parity chip in a memory address bank. For this test we used the Intel daughterboard A (in conjunction with piggyback board A) installed in an IBM AT.

The **Extended-Memory SIMM Size** test assesses the diagnostic package's ability to detect a chip mismatch in the Arche 386/33. We removed a defective 1MB module and replaced it with a functional 256K SIMM.

The **Compaq-Memory Diagnostic** test assesses the package's ability to detect a processor cache error when the Compaq Deskpro 386/25 reveals a memory error during the initial internal system test.

	AMIDIAG	CheckIt	DR-Chips	QAPlus	Service Diagnostics: The Kit
Extended-Memory SIMM	P	F	F	F	F
Extended-Memory DIP Speed	P	P	F	P	P
Extended-Memory DIP (consistent errors)	P	P	F	F	P
Extended-Memory DIP (intermittent errors)	P	F	F	F	P
Extended-Memory DIP (bent pin)	P	P	F	F	P
Extended-Memory SIMM Size	P	F	F	F	P
Compaq Memory Diagnostic	F	F	F	F	F

"Chances are the next time you go shopping for a PC, you'll take home a portable."

1. Site Parameters/Exit

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Desktop system as Editor's Choice, PC Magazine noted "With so much going for it how could you go wrong?"

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We're setting the pace in other ways as well. For instance, every ZEOS computer is backed by our 30 Day Absolute Satisfaction Money Back Guarantee, One Full Year Limited Warranty and our Express Parts Replacement Policy. You're going to be very satisfied. We don't just say it. *We Guarantee It.*

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The ZEOS Guide to the Perfect Portable:

PROCESSOR: PC Magazine recommends a 386SX processor, particularly if this is your only computer. We agree completely. Your ZEOS Portable uses the powerful Intel 386SX running at zero-wait state. Delivering true 32-bit processing power, the 386SX allows you to run the software of today *and* the software of tomorrow.

CO-PROCESSOR: Whenever you're ready, your new ZEOS portable is ready to accept the 80387SX math co-processor. Number crunching like never before!

VIDEO: Very important. The Perfect Portable offers full VGA at 640 x 480, don't settle for less. You get a full 16 grey scales with a state of the art plasma display. The big 8.25" x 6.25" size more than fits the bill. As PC Magazine says "the best ones are 8" x 6" or bigger." Perfect!

You can even run an external color VGA monitor while keeping both displays active. PC Magazine likes this feature noting that it's great for demos, classes and the like. You can sit off to the side and let others gather around the external display.

This feature is also nice when you want a larger color monitor for office or home as you move your portable in-between. And if you choose to use an external monitor alone, you can increase your resolution even further, right up to 800 x 600. Outstanding Video!

DISK DRIVES: Your system also includes its own high speed 42MB IDE hard drive along with a built-in 1.44MB 3.5" floppy drive. In addition, your ZEOS SX Portable features a disk interface port for an optional 5.25" external drive.

If you purchase the ZEOS SCSI Connection you can drive up to six additional devices. Virtually any SCSI device will work including tape drives, disk drives (up to 1.2 Gigabytes!) plus optical drives and more.

KEYBOARD CONSIDERATIONS: Featuring our pleasant Tactile/Click touch. Just like PC Magazine recommends, it has the full eight dedicated cursor-movement keys (rather than four keys that do double duty with a function key).

The keyboard isn't squeezed either. The distance between the "Q" key and the "[" (left bracket) key measures 7.5 inches, just as PC Magazine suggests. All the keys are of standard size. We have also provided a separate jack which allows you to plug in a standard 101-key keyboard if you wish.

CHECK IT OUT!

The Perfect Portable has many features of obvious importance. Also, there are a number of features that are subtle yet critical to your ultimate satisfaction. We'll go over them here one by one. We're confident you'll agree, the ZEOS 386SX Portable is in fact, the Perfect Portable.

CONNECTIVITY: We provide you with two extra expansion slots and give you some very exciting options as well.

For instance, how about a combination modem and Fax Card! This great little add on provides you with a full-fledged 2400 baud modem *plus* allows you to send data (including text, graphics, desk top publishing and spreadsheets) to any G3-compatible Fax machine anywhere in the world. Your system will also support virtually any other half-length cards including today's high performance network adaptors.

FCC & UL APPROVALS: FCC Class B. As PC Magazine says, "you should go for Class B because it takes smarter engineering and tighter quality control to achieve Class B." The ZEOS 386SX Portable is of course Class B. And we threw in UL approval for good measure. It isn't required, we did it for you!

WATCH THE DETAILS, TOO: Like extended Memory configurable as EMS 4.0 Expanded. Selectable Voltages for foreign travelers. Two RS-232 compatible serial ports (supporting baud rates from 110 to 9600 baud) and a Centronics compatible parallel port. Details you'll really grow to appreciate!

And the entire system has been ergonomically designed right down to adjustable screen viewing angles.

We think you'll agree. We've studied the market, we've studied the competition. And now we've designed the machine. It is in fact, the Perfect Portable! One quick phone call and your new ZEOS 386SX Portable will be on its way to you!

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Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
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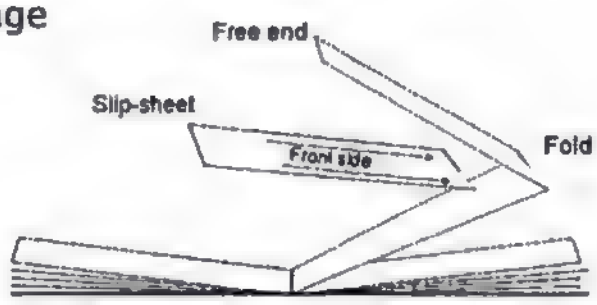
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

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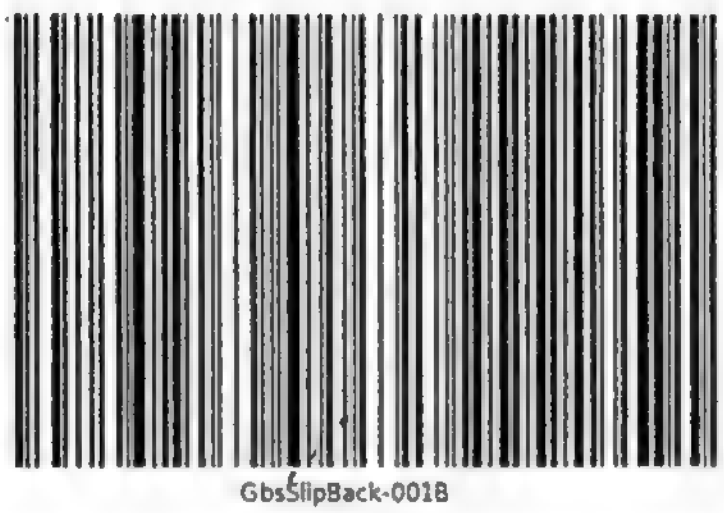
3. Slice the folded edge
4. Close the page and slip-sheet

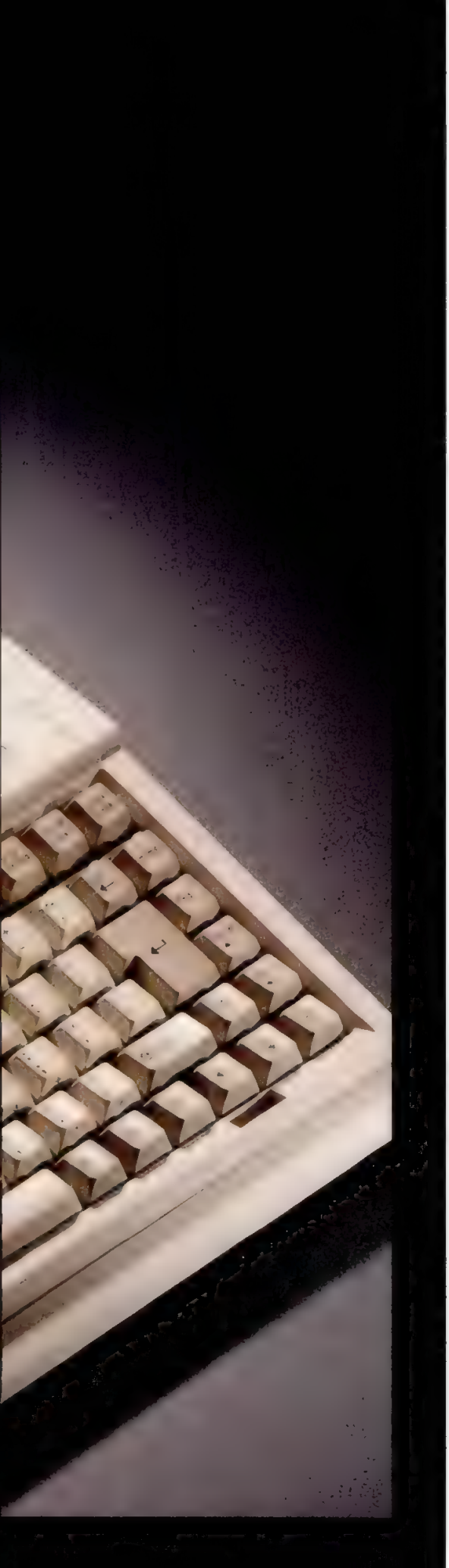


Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



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A lot of hard work. For the last two years the engineers at ZEOS have studied and restudied what it would take to build the Perfect Portable. The objective? Nothing less than to create for you the very best system at the lowest possible price. We knew it could be done.

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After all, ZEOS 386 machines have received *four PC Magazine Editor's Choice awards.* And PC Magazine selected ZEOS '386 systems *"For Overall Excellence"* above all others. Most recently, commenting on their selection of the ZEOS 386SX

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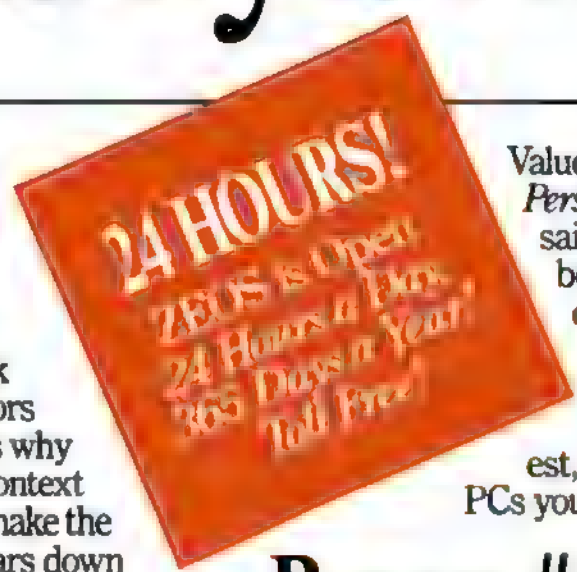

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editors Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7

Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Reason #10

You're Going to be Very Satisfied.

When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value.* We don't just say it, *we Guarantee it!*

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a. Your Personal Information

Requested Line of Credit $ _____

Your Name _____ First Initial Last **Date of Birth** _____ Mo Day Yr

Present Address _____ Street Apt. # City State Zip

Social Security Number _____ ( ) Home Phone

Date of Residence _____ Month Year **Monthly Payment** $ _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

_____ **Dates of Residence** _____ From To

Your Employer _____
(If self-employed, see rear panel.)

Date of Employment _____ Mo Yr **Position** _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

_____ City State Zip ( ) Business Phone

Previous Employer _____ **Address** _____

_____ **Dates of Employment** _____ From To

Other Income _____ I have received since (Date) _____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation

Monthly Income _____ Gross $ Net $

Name and Address of Nearest Relative Not Living With You _____

_____ Relationship _____

b. Credit Information

Include joint information, if joint account requested

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Loan Reference _____ Bank Name Address

_____ Payment _____ Balance _____

Bank Card Reference _____ Bank Name Address

_____ ☐ VISA ☐ Mastercard Payment _____ Balance _____

(please check appropriate box):

☐ **Joint Credit** with another person. Complete all information.
☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history.* This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card Reference _____ Bank Name Address

_____ Payment _____ Balance _____

Other Credit References _____ Payment _____ Balance _____

Account No. _____ Expires _____

Driver's License No. _____ State _____ Expires _____

c. Joint Personal Information

Joint Name _____ First Initial Last

Date of Birth _____ Mo Day Yr **Social Security Number** _____

Address _____ Street Apt. #

_____ City State Zip

Date of Residence _____ Mo Yr **Home Phone** ( ) _____

Employer _____

Date of Employment _____ Mo Yr **Position** _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

_____ City State Zip ( ) Business Phone

d. Self-Employed Information

Complete this section only if you are self employed

Business Name _____

Business Address _____

☐ Proprietorship ☐ Corporation ☐ Partnership **Business Phone** ( ) _____

Description of Business _____

Your Position _____ **In Business Since** _____

Your annual income from business _____ **Business' annual income** _____ (gross) (net)

You must provide at least one of the following:

1. Business Bank _____

( ) _____ Telephone _____ Personal Banker's Name

2. Accountant's Name _____

( ) _____ Telephone

3. Financial statement on business attached.

(TXC AK, & HI)

CIRCLE 115 ON READER SERVICE CARD

Of the eight tests we ran, *QAPlus* was able to catch only a hard error on an Intel Above Board installed in an IBM AT. In itself, catching only one of the eight isn't catastrophic—several of our tests deal with memory chips rated at different speeds and do not produce consistent errors; it's quite possible that no error actually occurred during the product's test cycle. Had *QAPlus* been allowed to run for several hours, or even overnight, it would have had a better opportunity to experience an error and report on it.

QAPlus should be more attractive to the 386 owner than *CheckIt*, providing a full range of system information, RAM diagnostics, *and* a correct memory map. Owners of 80286 and 8088 systems will also find this product to be a handy addition to their computer libraries.

Service Diagnostics: The Kit

It's obvious that *Service Diagnostics: The Kit* is a product intended for professional use. The $495 kit contains both XT- and AT-level diagnostic software, parallel and serial loop back plugs, floppy disk drive alignment disks, and SuperSoft's ROM PLUS ROM chips. The 80386 version of the diagnostic software is an additional $195 (no 80386 version of the ROM PLUS chips is available, but drive alignment

Service Diagnostics: The Kit lets you run diagnostic tests in either quick or intensive mode.

Compact Desk.

This pocket-sized box instantly turns a portable computer into a laptop office. Introducing the WorldPort 2496™ portable fax and data modem.

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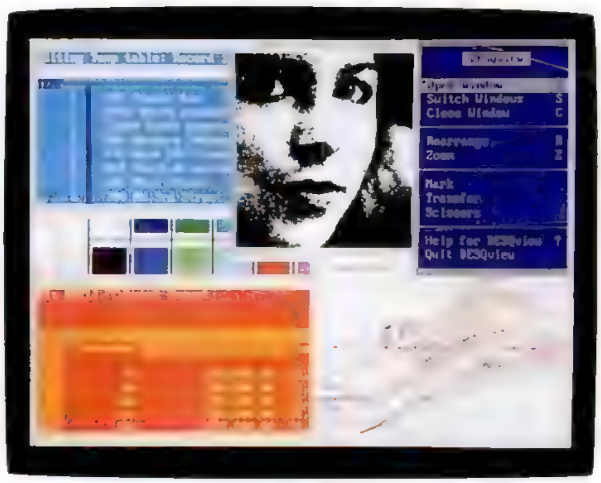

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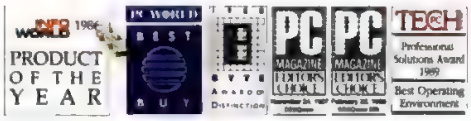

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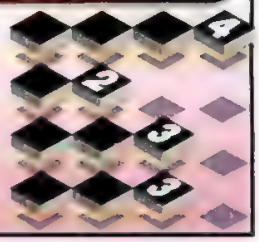
disks and loop back plugs from the basic kit are upwardly compatible).

The fact that you need an oscilloscope (one of the few tools not contained in the kit) to display the cat's eye pattern generated by the floppy disk drive alignment disks attests to this package's professional orientation. Additionally, technicians will find the ROM PLUS options essential replacements for the system ROMs in ATs or XTs that refuse to boot. Three ROM chips—one for an XT, two for an AT—contain the diagnostic software that would normally be loaded from a disk in a functioning computer. While all of the *Service Diagnostics* components are available separately, you'll find that the kit offers a significant savings over individual pricing—the ROM PLUS options alone cost $245.

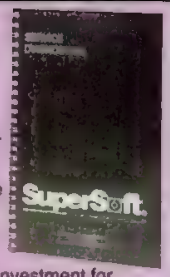
SUITABILITY TO TASK
Service Diagnostics: The Kit



Once beyond the awe-inspiring components, you're faced with deciphering the *Service Diagnostics* manual. Packed with information, it is written above the level that the average computer owner is able to easily understand or correctly interpret. Unfortunately, the illustrations don't offer much help either. They appear to be screen dumps of program segments rather than photographs or graphical treatments; you may find yourself confused when confronted with illustrations that contain notations indicating that certain options should be highlighted, but all that's visible is the screen dump's plain text. At its price level, *Service Diagnostics*' documentation should be more professionally presented.

The testing environment is straightforward and the RAM tests can be performed at two levels: quick or intensive. All of the PC Labs RAM diagnostic performance tests were conducted at the quick level because both the burn-in and Walking 1's tests that are part of *Service Diagnostics*' intensive environment require an extended amount of time for completion. In fact, these tests are actually meant to be run for several hours (or overnight, if possible) to detect intermittent problems, but it's amusing that the manual takes the time to

FACT FILE
EDITOR'S CHOICE



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PC MAGAZINE *Associate Editor*

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point out that it would require approximately 3.5 years to finish either one of them on a 20-MHz 386 machine with 10MB RAM. On the faster Arche 386/33 with only 8MB installed, the extrapolated running time would still be almost 1.9 years to completion.

Service Diagnostics is not copy protected and can be run from the DOS command line. It reads memory information from CMOS, but lets you adjust the memory size to account for installed RAM that CMOS might not have recognized. This is essential in an 80386 environment where CMOS automatically configures itself, and bad memory chips or modules can cause it to recognize less RAM than is actually installed. (For instance, when we reduced our 8MB Arche 386/33 to 7MB by replacing its last bank of 1MB SIMMs with a bank of 256K SIMMs, Arche's CMOS would recognize no more than the first 4MB.)

The end result of its initial memory scan (which doubles as a low-level passive memory test of its own) is a display of the current RAM contents, including conventional, extended, and expanded. The resulting map indicates the resident areas for the BIOS, the program, and reserved memory areas for shadowing; the actual memory display is more of a topological map of memory addresses and their contents than a physical map of the locations of the chips or SIMMs modules.

The quick version of *Service Diagnostics*' RAM tests were successful with five of the eight PC Labs RAM diagnostic performance tests. As did all the others, the program refused to run at all with an expanded memory driver resident; it also missed the processor RAM cache error in the Compaq Deskpro 386 and the intermittent glitch in the Arche 386/33. If and when the 386 version of the ROM PLUS chip appears, it will almost certainly deal with caching. It's also certain that running the software in intensive mode would have uncovered the Arche glitching within a few hours.

SuperSoft has other versions to test PS/2 models, V20, V30 or Harris computers, as well as the Unix and CP/M operating environments. If you're running a service department, *Service Diagnostics* is not an option—it's a necessity. ■

Bill O'Brien *is a contributing editor of* PC Magazine.

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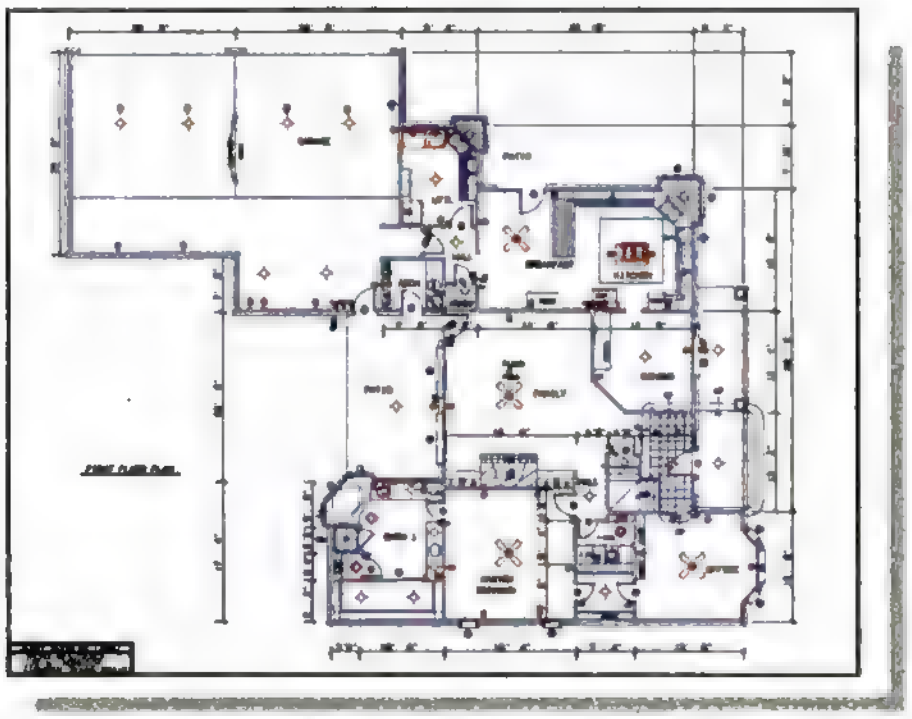

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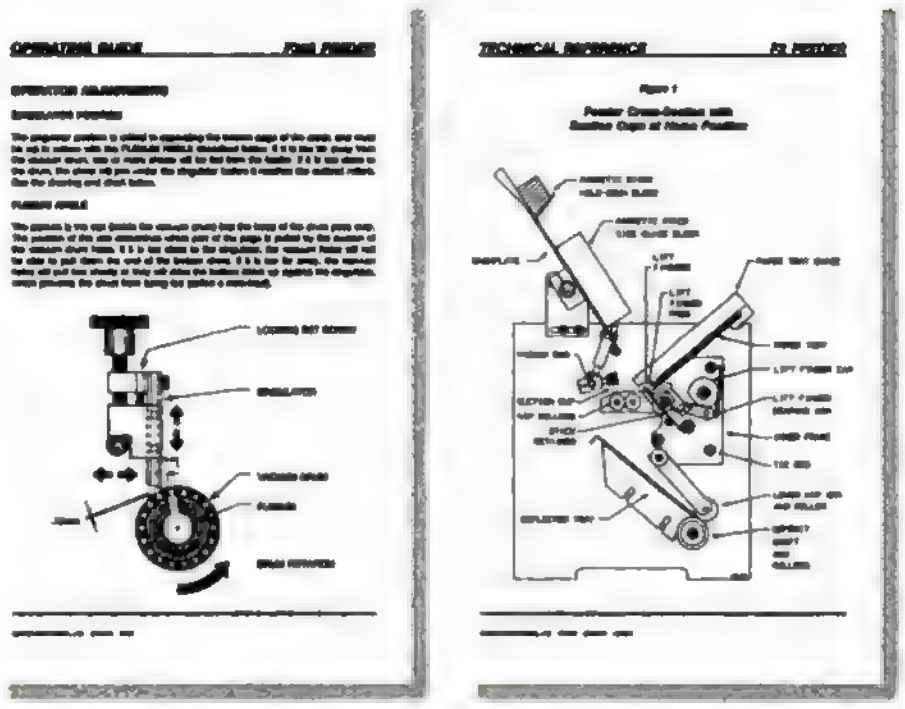

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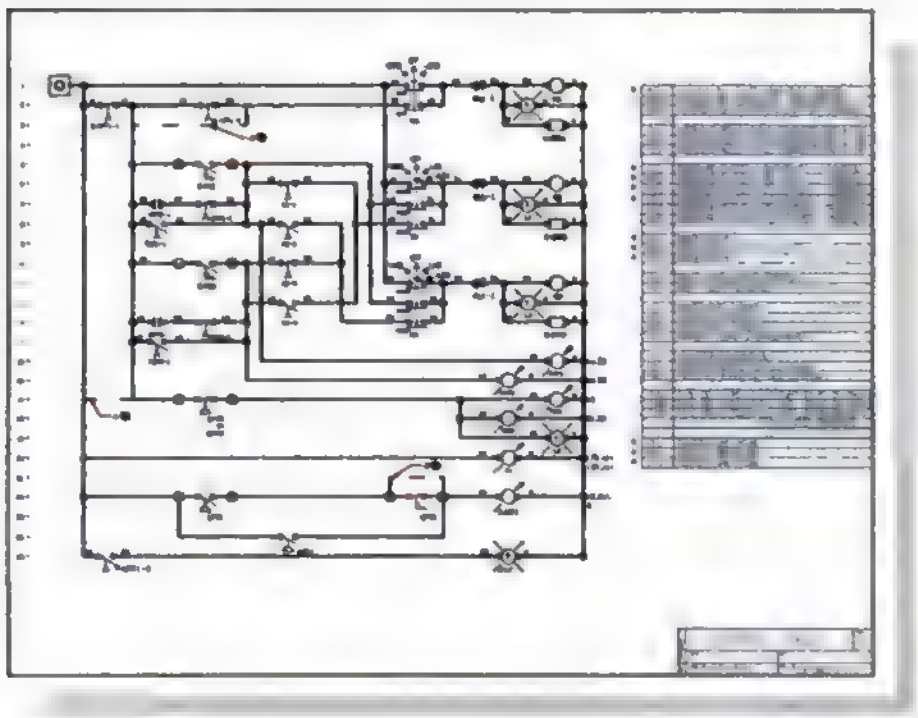

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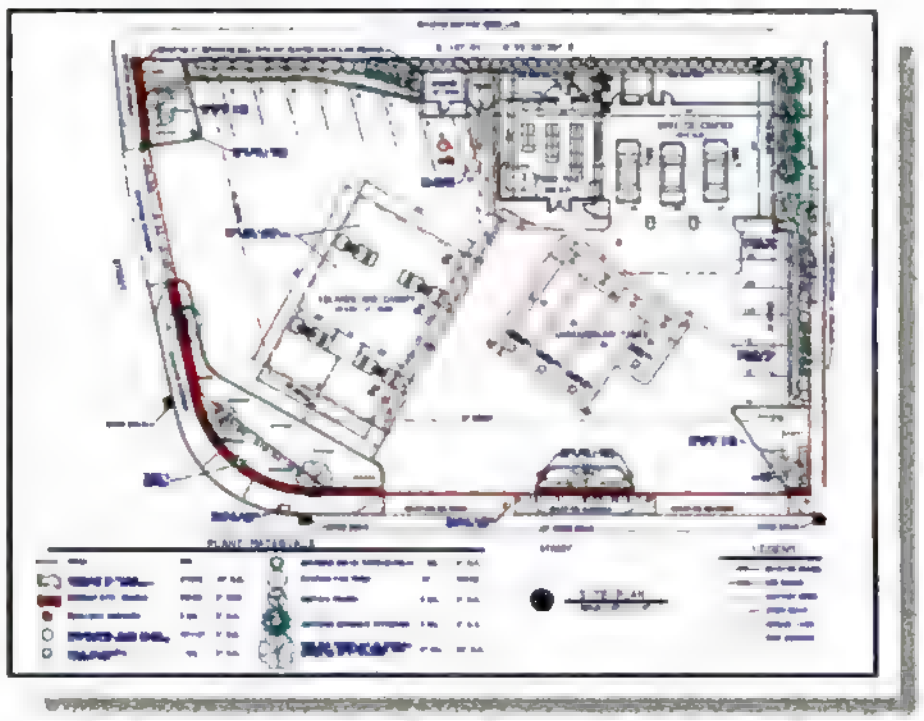

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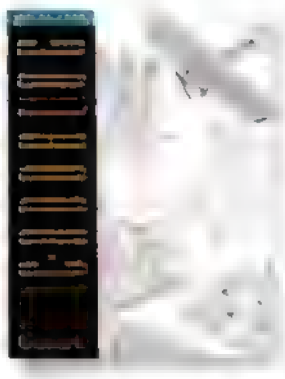

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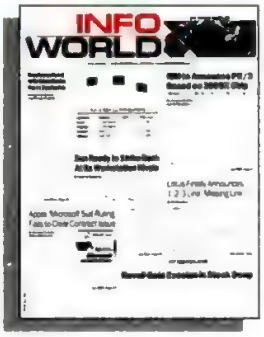

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MICE & TRACKBALLS

Choices for the New Generation of Applications

As you move to Windows 3.0 and other graphical environments, you'll need to find a pointing device to supplement your keyboard. To show you the way, PC Labs tests 34 mice, 20 trackballs, and 4 light pens.

Alternate input devices—mice, trackballs, light pens, and a myriad of related products—just got a whole lot more important. The catalyst is *Microsoft Windows,* Version 3.0, which shipped in May. *Windows* 3.0 is so good it will lure lots of PC users to the graphical user interface, where many applications have already migrated. Once users reach *Windows,* they're sure to discover that, by itself, the keyboard just isn't the right tool for the graphic environment.

What GUI users need most—okay, besides memory and a good display system—is a pointing device designed especially for the graphic world of icons and menus. For most GUI users, that device will be the mouse. Indeed, a lot of PC users have already taken home the little rodent: today, one quarter of all PCs have a mouse attached—up from only 10 percent three years ago, Microsoft reports (see "Mice for Mainstream Applications," *PC Magazine,* August 1987).

by Mary Kathleen Flynn

PHOTOGRAPHY ROBIN NEDBOY

REVIEW CRITERIA

It doesn't take a rocket scientist—or even a veterinarian—to predict that the mouse will continue to be the favorite input device for most GUI business users. That's why we've focused this review on mice—and their litter mates, trackballs. To make it into this article, a product had to be a mouse or a trackball; it had to work with a PC; and it had to be sold to end users. As always, it had to arrive in PC Labs on time and in working condition.

We chose not to review digitizing tablets or touch screens because they aren't appropriate for mainstream applications. Digitizing tablets are perfect for CAD users, but not for the rest of us. And touch screens are great in ATMs, where you need a pointing device as familiar as the finger, but for other applications, they're hard on the arm and they get dirty quickly.

In addition to mice and trackballs, we have included information on light pens from four vendors: FTG Data Systems, HEI Inc., The Lite-Pen Company, and Warp Speed Light Pens, Inc. For extended use, a light pen will tire your arm, but for point-of-sale and some hospital applications, a light pen makes a great pointing device (see the sidebar "Light Pens: The Specialized Alternative").

MOUSE MARKETEERS

When it comes to mice, Microsoft, of course, rules the road. In its 1990 fiscal year, which ended in June, Microsoft sold close to 2 million mice. That's *half* of all the alternate input devices sold for PCs. Based on Microsoft's research, Logitech is its closest competitor, with about a third of the market. In third place is IBM with 10 percent of retail sales. The remaining 10 percent, according to Microsoft, is divided up among many players, with none staking out a significant slice of cheese.

Not everyone shares the same view. Mouse Systems, the first company to deliver a mouse for the PC way back in 1982, paints a different picture. The long-time second-place player, Mouse Systems concedes that Logitech has moved into its former position but puts itself in third place with roughly 20 percent of the market. One explanation for the discrepancy is that Mouse Systems doesn't include IBM in its count because Big Blue sells mice bundled with systems through their dealers.

After the first tier, there are literally dozens of companies striving to fill the place beside your keyboard; 37 of them participated in this review. Some vendors specialize in alternate input devices: Kensington, KYE, and MicroSpeed all depend on pointing devices for their livelihoods. Then there are systems manufacturers—not just IBM but Tandy, for instance—who sell input devices usually (though not always) with PCs. And, there are keyboard vendors, such as Chicony and Key Tronic, who include mice and trackballs in their input product lines. Finally, there are a slew of mail order houses that sell inexpensive products manufactured in Asia.

Some companies you might have expected to see represented here didn't participate for a variety of reasons. Mitsubishi, whose E-Mouse won an Editor's Choice in our February 14, 1989 roundup, is letting Mouse Systems handle its mice, which are being sold through discount houses. Summagraphics has pulled out of the market altogether. At press time, Honeywell was about to launch a new product, which wasn't ready in time for review but should be available by the time you read this. Kurta makes the Penmouse, but it isn't a mouse at all; it's a digitizing tablet. Finally, Hewlett-Packard, Olivetti, and Packard Bell sell their mice primarily bundled with systems.

The first step in picking a pointing device is to weigh the pros and cons of a mouse against those of a trackball—the latter has gotten a lot of attention lately.

THE TRACKBALL REVISITED

For some users, the first step in picking a pointing device is to weigh the pros and cons of a mouse against those of a trackball. The trackball, often thought of as an upside down stationary mouse, has gotten a lot of attention lately. Two top mouse makers rolled out trackballs last fall: Logitech and Mouse Systems both claim that sales are meeting expectations. Today, there are almost as many trackballs as mice available for the PC—20 trackballs to 34 mice appear in the features table that accompanies this article.

Why is the trackball making a comeback? A look at the Apple community indicates an opportunity for trackball vendors in the PC market. Each Apple system comes with a mouse, yet 10 percent of Apple machines have trackballs attached to them, points out Dan Mertens, vice president of marketing for long-time trackball vendor, MicroSpeed. If the same percentage of PC users chooses a trackball over a mouse, we're talking about 400,000 trackballs sold each year.

Another explanation offered by Mertens is that, until recently, trackballs were prohibitively expensive. To solve this problem, MicroSpeed has revamped its trackball suspension system, creating a product that's both solid *and* inexpensive. Given the competitive prices of the trackballs reviewed here, other vendors appear to have done the same.

COKE VS. PEPSI

Pierluigi Zappacosta, president of Logitech, attributes the recent wave of trackball introductions to market maturity. "As an industry matures," he explains, "choice is the name of the game." Indeed, several vendors compare the mice versus trackball debate to the Coke versus Pepsi contest. "It's just a matter of personal taste," insists MicroSpeed's Mertens.

To date, Microsoft hasn't given in to the trackball craze. "I thought the mouse won a long time ago," exclaims Rick Thompson, product manager for Microsoft's hardware group. Convinced the mouse will continue to be king, Thompson doesn't say that either it or the trackball "is better than the other." So, why doesn't Microsoft make a trackball? "Because," he answers, "I just don't think the world needs another trackball." Thompson predicts a major shakeout in the input device market within a year. Indeed, early tremors are already there: Thompson points at Mitsubishi's seeming departure from the market. In addition, there's Summagraphics' exit and KYE's purchase of Mouse Systems.

Depending on your applications and your work habits, the choice between a mouse and a trackball may be more than just aesthetic. Tony Rodrigues, product marketing manager for Mouse Systems, says, "The mouse is better for freehand drawing applications, because you can move it around as you would a pencil. But,

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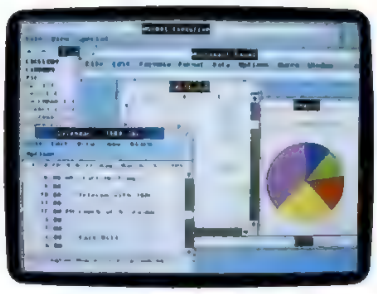

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for plotting points in CAD packages or just selecting menu choices, the trackball is better." Of course, the best choice for CAD applications is a digitizing tablet.

A MATTER OF ANATOMY

Another issue to consider is the ergonomics of each device. Using a mouse takes different muscles than does a trackball. The "Dove bar" design—named after the soap—of many mice makes them better suited to the hand than most current trackballs. Logitech's TrackMan and MicroSpeed's new PC-Trak may prove exceptions to the rule. On Logitech's trackball, the ball and buttons are separated so the thumb uses the ball, and the fingers use the buttons. And MicroSpeed's new trackball slopes like the "Dove bar," with the buttons surrounding the ball—which means the individual can decide how to use the buttons. For more information on ergonomics, see the sidebar "Mice vs. Trackballs: The Anatomy of a Choice.

If desktop real estate is prime, you may want to consider a trackball more seriously. Although most of the trackballs available today are larger than their mouse counterparts, using them takes up less space because they're stationary. This also makes trackballs easier to find on a cluttered desktop. Of course, many of today's mice support higher resolutions and ballistic tracking, which cuts down on their space requirements (see the subheadings "Resolution" and "Ballistic tracking" for more information).

If you do go with a trackball, see the reviews to make sure you choose one with a Drag/Lock button or function; hanging onto a button with your finger while rolling the ball is almost as awkward as patting your head while rubbing your stomach.

If you're a mouse user who's tempted by the trackball's benefits, rest assured that going from the mouse to the trackball is much easier than going from the keyboard to the mouse. In fact, some of our reviewers who use mice in their daily work resisted the trackball initially, but, after using a trackball for an hour or so, said going back to a mouse felt strange. And, trackball vendors don't seem fazed by the resistance of current mouseophiles, explaining that many of their potential customers are still pointing device virgins and are willing to consider a trackball.

Nobody expects the trackball to overtake the mouse. Even the trackball's most ardent fans—vendors themselves—don't expect trackball sales to occupy more than 10 to 20 percent of current mouse sales. A solid niche market is what the vendors are seeking.

ODDBALLS

In addition to mice, trackballs, light pens, digitizing tablets, and touch screens, there are a bunch of "oddball" technologies. In the last two years, we've seen a number of new twists: the IsoPoint, a below-the-Spacebar rolling cylinder; GRiDPad's "electronic pen," which recognizes handwritten characters; CalComp's Wiz Mouse System (reviewed here), which bundles an electromagnetic mouse-like device with application-specific templates; foot pedals—as a standalone product, in the case of PC Pedal, and as an adjunct to a trackball, in the case of the Kraft Trackball (also reviewed here); Datadesk's modular keyboard, which can be configured with different devices including a trackball; and Home Row, a technology being licensed to keyboard vendors that modifies the "J" key, turning it into a miniature trackball-like device. But it's too soon to tell if any of these innovations will have a significant impact.

PORTABLE POINTERS

The hot spot for pointing devices in the near future will be laptops and portables. Most system manufacturers and input device vendors seem to agree that the mouse is *not* the best pointing device for portables, but the right device remains to be discovered. Vendors are exploring all kinds of options: small standalone devices that attach to the keyboard, like Mouse Systems' Little Mouse for the Macintosh Portable and Suncom's new miniature joy stick; built-in products like the Chicony combination keyboard and trackball (reviewed here); the IsoPoint—as well as an optical implementation of the IsoPoint from Mouse Systems; and the new Home Row technology. The trick is to balance real estate and weight concerns with ergonomics and user habits.

Another issue under debate is whether a device should be bundled with a portable or left as an after-market sale. Some vendors are questioning whether or not there'll even be a separate input device market for portables: Why not just take your desktop device with you on the road, they ask.

So far, all that's happened is that everybody's talking to everybody else. The good news is that Fall Comdex will be hopping with portable pointing devices.

TAKE YOUR PICK

But, for the desktop environment, there's no reason to delay making a decision. With 54 mice and trackballs represented

here, there's at least one is bound to please you.

To compare features at a quick glance, turn to the table, which is organized alphabetically by vendor. (For vendors with more than one offering, the products are arranged by price, beginning with the least expensive.) The table includes every current input device offered by the vendor—whether or not it was sent here for testing. Here's a summary of the more important features to examine.

Price. You can buy a pointing device for anywhere from $35 to $250. As is usually the case, the more you pay, the more you get. For the sake of comparison, keep in mind that the Microsoft Mouse, with *PC Paintbrush*, is $150. With the full version of *Windows* 3.0, the Microsoft Mouse is $225. (Microsoft is no longer selling it with a runtime version of *Windows 286*.) By the time you read this, Microsoft will be selling the mouse by itself for $125, which should translate into a street price of less than $100.

Drivers. There are several different kinds of drivers for mice and trackballs, making the issue a bit complicated. Drivers can come with either the application or the device. They can be generic or application specific. And they can be proprietary or they can emulate a popular driver.

For many users, the only drivers that matter are the ones that come in their applications. *Windows* includes drivers for products from Microsoft, Mouse Systems (for three buttons), Logitech, Hewlett-Packard, IBM, and Olivetti. Just enter the right driver in *Windows*, and you're all set. If you're considering a device that's not explicitly supported by *Windows*, never fear: Almost all the mice and trackballs in this roundup emulate the Microsoft Mouse or the Mouse Systems mouse—many emulate both. And, the features table will tell you which devices can just "plug" into the Microsoft Mouse driver in *Windows*.

Also included with most of the products here are generic DOS-level device drivers: a .COM driver you can load at the command line as a TSR or a .SYS driver you put into your CONFIG.SYS file. Many products offer both. Take a look at the size of these files on the features table; the current Microsoft Mouse driver takes up over 26,000 bytes. If RAM cram is a concern of yours, look for devices with drivers that can be uninstalled from DOS (they're listed on the features table). And remember: a .SYS file—which is generally smaller than its counterpart .COM file—can be dis-

MICE VS. TRACKBALLS: The Anatomy of a Choice

Mice continue to dominate the alternate input marketplace, but the trackball is gaining ground. Our anatomy expert tells you which of the two devices will make it easier for you to keep a firm grip on your work and why.

by Lorraine Rice

The development of graphical user interfaces (GUIs)—and the mice and trackballs that make them work—is the latest extension of the most basic of human hand signals: pointing. Which pointing device is best for the computer user, and which is better suited to the hand is a matter of anatomy.

HAND TO MOUSE

PHOTOS: THOM O CONNOR COMPUTER ENHANCEMENTS: CHARLES CONOVER

The "Dove bar" design, originated by Microsoft, is well suited to the hand. Because the case slopes down, your hand stays in a relaxed, bent position. And, moving the mouse on your desktop uses your arm muscles, which are stronger than the muscles in your fingers.

A LITTLE ANATOMY

There are dozens of individual bones in the human hand and wrist. All of them meet with at least one other bone by means of free-moving joints. The wrist bones also meet with the two bones of the lower arm: the radius (found on the thumb side) and the ulna (found on the pinkie side—and in crossword puzzles).

The combination of these types of free-moving joints gives the hand its versatility. In whole or in part, the hand is capable of the following: bending, known in medicalese as flexion; straightening, also called extension; moving away from an imagined midline, known as abduction (like in the Vulcan salutation, "Live long and prosper!"); and moving toward an imagined midline, adduction (as in "I swear to tell the truth"). Other movements include side-to-side movement (transverse), and rotational movement.

The thumb metacarpal meets the wrist bone in a special joint known as a saddle joint. This gives the thumb its great range of motion. The thumb can oppose every other finger, resulting in a precision grip (like writing with a pencil) or a power grip (holding a drinking glass).

MOUSING AROUND

The design of most mice seems admirably suited to the musculo-skeletal properties of the hand. The edges of the mouse fit the edges of the fat pads of the palm. The pinkie grasps one side of the mouse while the thumb holds the other side in a power grip. This cups the hand around the mouse in a comfortable and relaxed position with no

overt bending or straightening necessary.

The three middle fingers are left free for pushing buttons. And because bending and straightening are the only possible motions of the joints between the finger bones and those between the palm and wrist, these three fingers are ideal for pushing buttons.

In this way the mouse makes efficient use of the hand muscles by letting them accomplish fine cursor movement, while the larger muscles of the arm and shoulder handle larger cursor movements.

ON THE OTHER HAND

The general design of most trackballs does not use the design of the hand efficiently. Logitech's TrackMan and MicroSpeed's redesigned PC-Trac (both reviewed here) are two notable exceptions. Although it generally takes up less desk space, the trackball's case tends to slope up and away from the user, causing constant, tiring extension of the hand muscles. The ball tends to be located in the middle of the device, and the buttons are usually located around the ball or on the casing's sides.

If the user moves the ball with the fingers, they are not readily available for use on the buttons. Conversely, if the user moves the ball with the palm, the fingers must be lifted off the device during button presses and then repositioned for moving the ball. On the mouse, the fingers remain in contact with the buttons, and repositioning motions are unnecessary.

Remember, too, that the joints between the finger bones are only capable of bending and straightening. If the fingers are used to move the ball, much side-to-side motion of the wrist is required to change the ball's direction. If you use the thumb—the thumb's universal joint is ideal for an entire range of cursor motion—the hand again must be repositioned over the buttons.

A BETTER TRACKBALL

A trackball that would best use the hand's design is one that uses the thumb's flexible joint for manipulating the ball and the index and middle fingers to push the buttons. Thus, the hand would not have to move off the device; nor would there be concern about the hand's size or the length and stretch of the fingers. Of course, the manufacturer would have to make two versions, one for right-handed and one for left-handed users.

Logitech makes such a trackball, the TrackMan (reviewed here). Our only complaint is that it's designed for right-handedness—of course, many left-handed people use mice and trackballs with their right hands. MicroSpeed's new version of the PC-Trac is also a superior design. The case slopes like the "Dove bar," letting your hand relax. And, because the buttons surround the ball, there are lots of positions to use the device effectively.

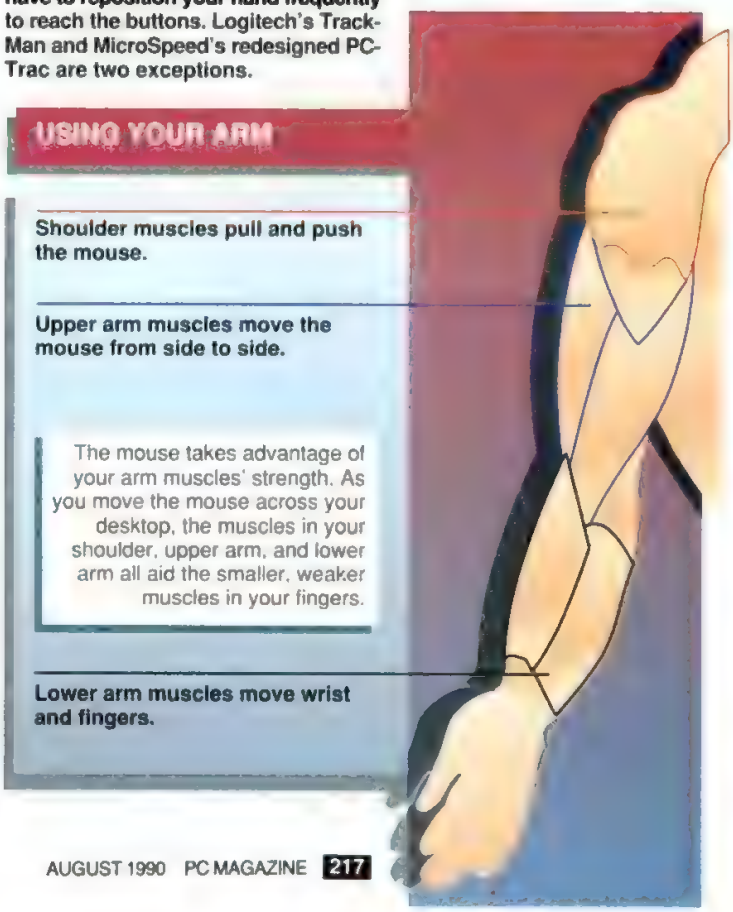
AND THE WINNER IS?

Because each device has its purpose in specific applications, it is difficult to pick one winner. Although the mouse has some ergonomic advantages over the trackball, advances in trackball design have made them increasingly comfortable and efficient. The answer? Test a variety, and let your fingers do the talking. ■

TRACKBALL FATIGUE

The standard trackball design has two flawed ergonomic points. First, you have to keep your hand straightened up, which takes more strength than keeping it bent down and relaxed. Second, you have to reposition your hand frequently to reach the buttons. Logitech's TrackMan and MicroSpeed's redesigned PC-Trac are two exceptions.

USING YOUR ARM



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abled, but it still takes up memory.

Finally, some devices come with application-specific drivers, which will let you use fancy features such as ballistic tracking and button remapping (see "Ballistic tracking" and "Buttons"). Once you've bought a product, check the manual to see whether or not the application driver includes the generic driver; if it does, don't waste your memory loading the generic one.

Resolution. For users of high-resolution applications and monitors, the input device's resolution will matter. The standard today is still 200 points per inch (ppi). Most of Logitech's products support 320 ppi; its new PS/2 devices offer 400 ppi. Microsoft has moved to 400 ppi, no longer selling its 200-ppi mouse. Mouse Systems currently goes as high as 350 ppi but believes that accuracy is more important than base resolution (see "Position sensors," for more information). What all these points per inch mean is the higher the resolution, the less you'll have to move the device across your desktop.

Ballistic tracking. Ballistic tracking, or ballistic gain, changes the cursor's speed relative to your movements. The faster you move the device, the farther the cursor will travel on the display. A related, though less sophisticated, feature is acceleration (which simply speeds up the cursor), offered by such products as the Kraft Trackball (reviewed here). While some users are unnerved by ballistic tracking, others swear by it. Check the reviews to make sure you can adjust this feature, including turning it off if it annoys you.

Position sensors. Mice and trackballs use three different position sensors: mechanical, optomechanical, and optical.

Which sensor is used may or may not matter to you, but people at Mouse Systems have been known to lose sleep over this burning issue. Although the company offers products based on each type of sensor, its focus is on the high-end optical PC Mouse line. One benefit of an optical sensor is the lack of internal moving parts. Another is accuracy: Mouse Systems' new PC Mouse III offers dramatically improved accuracy, which is important in CAD and high-end desktop publishing applications, though not particularly noticeable in mainstream *Windows* programs.

One perceived drawback to optical mice is that they require a special pad, usually made of highly reflective material and ruled into a grid pattern. The optical sensor in the mouse tracks its path along the grid by reading the reflected light. Some users find this not only inconvenient but space consuming. However, the pad that comes with the PC Mouse III is tiny, indicating that accuracy does make a difference.

The Microsoft Mouse is mechanical, which means it does have moving parts. Before buying a mechanical mouse, check the features table to make sure you can remove the ball easily for cleaning, as you can with the Microsoft.

Like Logitech's rodents, most of today's mice are optomechanical. An optomechanical device uses a ball that spins a wheel, which in turn interrupts a light source that can then be interpreted by the sensor.

Bundled applications. The software that comes with a device may make less of a difference than you think. Our reviewers had lots of fun playing with the paint programs and games that were bundled with various devices, but these extras weren't enough to make or break a product. Similarly, menus for popular programs and menu generators are nice bonuses, but not essential. Microsoft's decision to sell its mouse without software is just one indication that most users already have the programs they want. To find out what software comes with each device, turn to the reviews.

Beware of companies that know next to nothing about the devices they sell. While it's true that mice and trackballs require little support, when they do, a low price doesn't always make up for a frustrating—and fruitless—phone call.

Interfaces. Be sure to get a device with the right interface for your system. (Check the features table.) A serial mouse takes up a COM port; a bus mouse takes up an expansion slot. Most vendors offer both, with the serial version being about $20 less expensive.

The current Microsoft Mouse uses an interface called the InPort—essentially a bus mouse with added hardware features. MicroSpeed also manufactures interfaces for the InPort.

IBM PS/2s have a special port called the Pointing Device Port (PDP), which supports the mouse on the motherboard. Calcomp, Kensington, KYE, Logitech, Microsoft, MicroSpeed, and Mouse Systems also offer products for the PDP. One Logitech offering can be used with either the PDP or a serial port. And Mouse Systems' new PC Mouse III can be used with a serial, bus, or PDP interface.

Buttons. One feature that's become something of a non-issue is the number of buttons—one, two, three, or more. Microsoft adopted two; consequently, most applications support two buttons: a primary one for making a selection and a secondary one for adjusting it. Even Logitech, long an advocate of three-button mice, admits that support for the third button is minimal and, in fact, now offers a two-button mouse.

But, Logitech president Zappacosta insists that future applications will make good use of the third button. In the conventional Unix environment, he points out, it is used to call up menus. And, these days, even IBM is straddling the fence to some extent by offering a two-button mouse manufactured by Alps for its PS/2s as well as a three-button Logitech mouse for its new RISC workstation. But, for the present, most PC users are safe with two-button rodents.

If you're left-handed, you may want to remap the buttons; see the reviews to make sure you can do so before you buy. By the way, most left-handed people use their right hand for mice and trackballs anyway. But flexibility in how the buttons can be used is important not only to left-handed people. Look for designs like MicroSpeed's new trackball; the buttons surround the ball, letting you use them any way you want.

Design. Because the look and feel of these devices is truly subjective, we've steered away from making judgments—except for occasional comments on the most clunky or graceful designs. Your best bet is to borrow a Microsoft Mouse and see how you like it. Then take a look at the photos that accompany each review to see if there's anything out there that appeals to you. (Note: although not

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every *product* is pictured, rest assured that each *design* does appear in the photo accompanying the review.)

Technical support. Finally, beware of companies that know next to nothing about the devices they sell. While it's true that mice and trackballs don't require much support, you never know when you might need help. You should keep in mind that a low price doesn't always make up for a frustrating—and fruitless—phone call. In the reviews, we've noted the worst offenders.

Even with more than 50 products from which to choose, chances are you'll decide on the Microsoft Mouse. But if you're inclined to shop around, just sit back and read the reviews that follow. They're arranged alphabetically by company name.

ANTEC INC.

•Artec Mouse AM-21 Plus

by Nathaniel Zeinick

At $35, the Artec AM-21 Plus, distributed by Antec Inc. of Fremont, California, is among the least expensive products we reviewed. But Antec, which also produces light pens, should consider a side business in exercise machines. Hard-core mouse users will quickly develop Schwarzenegger-like fingers from this little bruiser's awkward boxy shape and three stiff buttons.

Ergonomics aside, this serial device has the features any casual mouser needs. A simple switch on the bottom makes it both Microsoft- and Mouse Systems-compatible and, at 356 ppi, it provides excellent low-resolution pointing capabilities. It also functions admirably under *Windows*.

Setup is a painless, no-frills affair. The cable plugs into a 9-pin serial port (a 25-

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pin adapter is provided as well) and simple disk- or manual-based instructions guide you through hard disk installation. You'll have to change your AUTOEXEC.BAT and CONFIG.SYS files yourself, but the price more than makes up for this minor inconvenience.

The AM-21 Plus uses proven optomechanical technology. A simple rotation and release of the plastic plate on the bottom drops the rubber-coated ball into your hand for quick cleaning. A 96-inch cord gives you plenty of room to maneuver, and also included are *Dr. Halo Plus* (Media Cybernetics Inc.), a cutting pad, and a cute blue mouse coat.

The Artec AM-21 is unremarkable except for its three input buttons that require more strength than constant users may like. But if you're an occasional mouse user and you're hunting for a bargain, the Artec Mouse may be right for your pointing and clicking needs.

Artec Mouse AM-21 Plus
Artec Inc., 4555 Cushing Pkwy., Fremont, CA 94538; (415) 770-1200.
List Price: $35.
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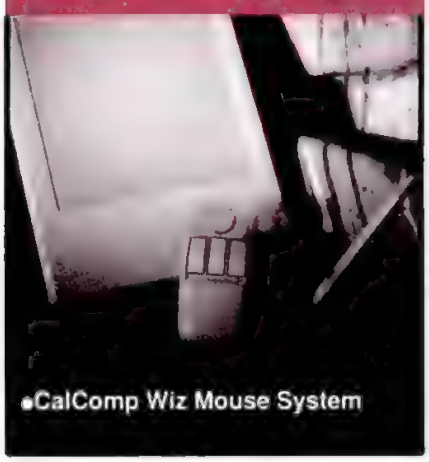
CALCOMP INC.



•CalComp Wiz Mouse System

by Bill O'Brien

The word mouse can be applied in only its most generic sense to the $199 Wiz Mouse. This mouse is dependent on CalComp's Intelligent Interface Tablet, a down-sized version of a graphics tablet. The tablet is about the size of a softcover book—roughly the area needed by a mouse. For $75 more, you can also purchase the optional Wiz Pen, which can be plugged into the tablet in the Wiz Mouse's place and used much like a digitizer.

Unlike most of the mice reviewed here, the Wiz Mouse has no rolling ball. Under the tablet's top layer are a host of electromagnetic sensors that track the mouse's progress, giving it a virtual resolution of 1,000 ppi.

The benefit of this arrangement is that it precisely defines the boundaries of the pointing device's travel without being dependent on the mechanical resolution of the device itself. It also permits you to define bounded areas in which the pointing device is able to perform special functions and create overlay templates, much as you would with a graphics tablet.

Standard equipment includes both DOS and *Microsoft Windows* templates that contain full DOS and *Windows* commands, available at a click of one of the Wiz Mouse's three buttons. Each button has a forward and rear mounted switch for a total of six functions. Priced at $49 each, templates and the drivers needed to recognize them are available for many software packages, including *Lotus 1-2-3*, *AutoCAD*, *dBASE IV*, *Microsoft Word*, *PageMaker*, and others. CalComp tells us that more are on the way.

The real challenge is the Wiz Mouse interface. As an independent pointing device, the Intelligent Tablet plugs directly into the serial port, taking its power from a jumper plug placed in line with the keyboard connector. Note that a few computers will not permit this and CalComp will provide you with a free external power supply should you require one. As a replacement for your current Microsoft mouse, an additional adapter lets the tablet connect directly to the mouse port.

CalComp asserts that its Wiz Mouse will perform identically to a Microsoft Mouse but can be switched over to an absolute mode that brings its performance closer to the fine resolution found in a graphics tablet.

If you're a user of CAD or desktop publishing software, and the flexibility of a mouse and the detailing ability of a graphics tablet in the same device appeals to you, the Wiz Mouse and Wiz Pen are worth investigating.

CalComp Wiz Mouse System
CalComp Inc., 2411 W. La Palma Ave., Anaheim, CA 92801; (800) 458-5888, (714) 821-2000.
List Price: Intelligent pad with Wiz Mouse, $199; optional Wiz Pen (requires pad), $75; application templates, $49.
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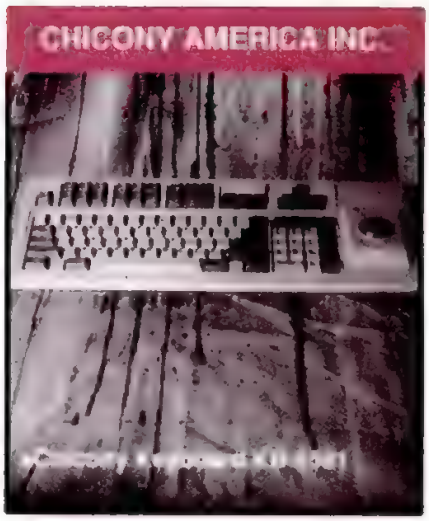
CHICONY AMERICA INC.



by Kellyn S. Betts

Are you truly strapped for desk space? For $99, Chicony's Keyboard KB-5581 gives you 101 keys and a trackball, but takes up only as much room as a standard 101-keyboard.

Like all Chicony keyboards, this one comes in three key-click varieties: hard, soft, and none. Its dual feet allow three height adjustments, and its 81-inch, dual-headed cord—sporting plugs for both keyboard and serial ports—can be channeled to the keyboard's right or left side.

In addition to menuing software, the KB-5581 comes with a simple but thorough RUNME program that explains installation options and allows users to test software-adjustable resolution settings. The trackball's maximum resolution is 200 ppi, and it provides no ballistic tracking.

For all its advantages, the addition of the trackball to the keyboard does have a significant drawback: In order to provide both 101 keys and a trackball, Chicony placed the function keys above the number keys in two horizontal rows. This unfortunate positioning makes it easy to press the wrong function key either instead of or in addition to the intended one.

If this alteration doesn't matter to you, you may find Chicony's trackball/keyboard hybrid an interesting alternative. For a price less than that of many plain keyboards, you get one with a three-button pointing device that, with practice, can behave just like a Microsoft or Mouse Systems mouse.

Chicony Keyboard KB-5581
Chicony America Inc., 1641 W. Collins Ave., Orange, CA 92667; (714) 771-6151.
List Price: $99.
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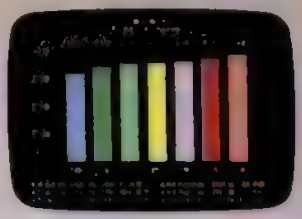

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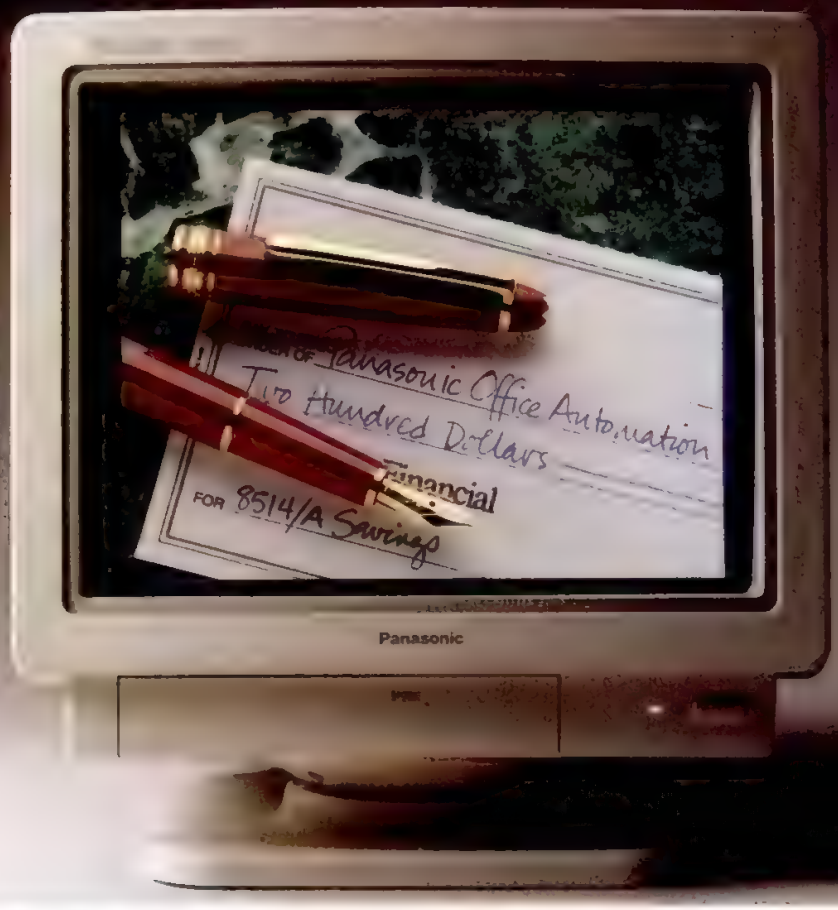

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M3-PCM

CH PRODUCTS INC.

by Sharon Terdeman

To those of us with perennially cluttered desktops, turning a mouse upside down to keep it still seemed like a good idea. But early trackballs didn't quite make it. They weren't always compatible, and to drag an object across your screen you had to hold down a button while rotating the ball—a finger-numbing exercise.

CH Products' RollerMouse changes all that. The $129.95 RollerMouse is available in four models: serial, bus ($149.95), PS/2, and Apple Macintosh ($119.95). Installation couldn't have been easier. I plugged it in, called up *Microsoft Windows*, and clicked away. To configure other applications, you simply select the Microsoft Mouse as the input device.

The RollerMouse's standard driver emulates the Microsoft Mouse, and CH Products includes software for creating your own pop-up menus. Three prewritten menus are included for DOS, *Lotus 1-2-3*, and *WordPerfect*, Version 4.2. CH Products claims that it will release a Mouse Systems emulation soon.

RollerMouse has four buttons. Two large ones act identically to those on the Microsoft Mouse, and two smaller buttons provide a locking function that allows you to select an object and drag it across the screen without the difficulty of holding down a button while rotating the ball.

The click and click-lock functions are right- or left-hand selectable using the mode selection switches located on the trackball's underside. And you can further customize the RollerMouse by using these switches to halve or double the cursor's speed. On the serial model, this can be accomplished without leaving your application.

The RollerMouse feels solid. Cursor movement is positive and precise with a maximum resolution of 400 ppi, and ballistic tracking lets you move speedily around the screen.

If your desktop hasn't got the room for mouse movements, the RollerMouse is right on track.

RollerMouse
CH Products Inc., 970 Park Center Dr., Vista, CA 92083; (800) 624-5804, (619) 598-2518.
List Price: Serial model, $129.95; PS/2 model, $129.95; bus model, $149.95.
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CMS ENHANCEMENTS INC.

by Mitt Jones

CMS's line of playfully named pointing devices won't win any awards for originality, but they do score points for value, solid design, and especially for their lifetime replacement warranty.

CMS's four versions of the Mini Mouse are based on the same three-button mechanical mouse design—a design that's very similar to that of the ProCorp and SmarTEAM mice reviewed here. At the bottom end of the range, the $99.95 serial version and $109.95 bus version offer 250-ppi resolution. The two 350-ppi versions, one serial and one bus, list for $129.95 and $149.95, respectively. Each version comes bundled with *Dr. Halo III* (Media Cybernetics Inc.), menu-generation software, and Microsoft-compatible CONFIG.SYS and command-line drivers.

Even though the Mini Mouse has three buttons, you won't be able to use the middle one when your mouse is configured to emulate the Microsoft Mouse. Nevertheless, the Mini Mouse works well with the

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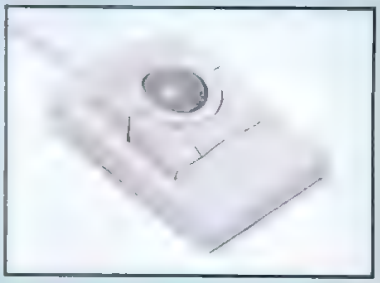

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Microsoft Windows mouse driver. If you want to create three-button drivers for the Mini Mouse using the menu software, you'll need to request a proprietary driver, which CMS will send free of charge.

To install the serial versions of the Mini Mouse, simply plug the mouse cable into either a 9- or 25-pin serial port and copy the CMS software to your hard disk. If you attach the mouse to anything but the first COM port, you'll need to add a simple parameter to the mouse driver command.

Bus versions support card installation as COM1 through COM4 and can be set via a bank of four jumpers. The documentation is confusing about what to do with which jumpers, but it isn't difficult to determine the correct settings.

You'll probably want to look elsewhere if you need to create mouse drivers for text-based programs. Though capable of creating powerful drivers, as evidenced by the supplied drivers for *Lotus 1-2-3* (through version 2.*x*) and *WordPerfect*, Version 4.2, the menu-maker programming language and compiler will be too intimidating for many users and too much trouble for many others.

CMS's line of playfully named pointing devices won't win any awards for originality, but they do score points for value and solid design and especially for their lifetime replacement warranty.

On the other hand, if what you need is a high-quality, inexpensive, Microsoft-compatible mouse, the Mini Mouse is a good choice—especially if the idea of a lifetime warranty appeals to you.

CMS Mini Mouse
CMS Enhancements Inc., 1372 Valencia Ave., Tustin, CA 92680; (714) 259-9555.
List Price: Hi-res bus model, $149.95; hi-res serial model, $129.95; standard bus model, $109.95; standard serial model, $99.95.
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ALTERNATE INPUT
MICE AND TRACKBALLS

COMMAX INC.

•Fancy Mouse
•Witty Ball

by Robin B. Bornstein

Although not as "fancy" or "witty" as their names suggest, the $45 Fancy Mouse and the $78 Witty Ball from Commax each offer one or two noteworthy features. Other products from Commax not submitted for review include the $35 Witty Mouse, a stripped-down sibling of the Fancy Mouse, and products for other platforms such as Amiga and Atari.

For both the Fancy Mouse and Witty Ball, each of which has three buttons, set the switch to Microsoft mode and you have a two-button pointing device; switching to Mouse Systems (PC) mode activates the middle button. Use the interactive test program to make sure your device is performing correctly: when you push a button on the device, an on-screen representation responds by showing the corresponding button as depressed. The Fancy Mouse sports ballistic tracking with a resolution ranging from 360 ppi to 1,050 ppi. Witty Ball does not support ballistic tracking, and its resolution is 300 ppi.

Setup is relatively easy. Simply connect the device to the serial port and load the MOUSE.BAT or MOUSE.COM driver; you can also uninstall the driver from DOS. In addition, the Microsoft Mouse driver in *Windows* recognizes both devices. The manual, which is the same for both products, guides you through the installation procedure, but it's riddled with typos and some incorrect information.

I checked out the paint program bundled with both these products and was pleasantly suprised at its complexity. In fact, most of the manual is devoted to explaining the various features of the paint program.

The Witty Ball's design is practical, but does call for one caveat for left-handed users: The buttons, which you can lock, are placed to the left of the ball. This design does improve your control over the cursor by freeing your palm and fingers to stretch across the ball, but it may be awkward for lefties.

The Fancy Mouse and the Witty Ball are solid performers, although the Witty Ball occasionally left the cursor hanging unless there was more pressure on the ball. Aside from their sloppy documentation, you'd be smart to check out these two inexpensive pointing devices.

Fancy Mouse
Witty Ball
Witty Mouse (not reviewed)
Commax Inc., 15 Shire Way, Middletown, NJ 07748; (201) 671-0775.
List Price: Fancy Mouse with pocket and mouse pad, $45; Witty Ball, $78; Witty Mouse, $35; 9- to 25-pin adapter, $5; mouse pad, $5.
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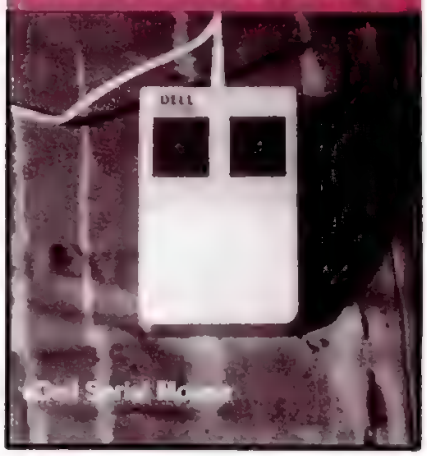
DELL COMPUTER CORP.



by Stephanie Izarek

Manufactured by Logitech for Dell and competitively priced at $59.95, the Dell Serial Mouse is the company's only alternate input device.

The 200-ppi-resolution Serial Mouse is a light, sleekly designed, two-button, optomechanical model that glides smoothly across a desktop. The tracking ball is placed in the front of the device, and the case slopes toward the back, making it comfortable to use.

The buttons require a light touch, making double-clicks effortless. Although this moderately priced model lacks some of the features—such as ballistic tracking—found in other, slightly more expensive mice, it performs well.

Dell packages its own installation software with the mouse, a complimentary copy of Paul Mace's *Pictor* paint program, and a concisely written manual that makes installation and setup a breeze.

The Dell Serial mouse performed well under *Microsoft Windows*. It includes an *AutoCAD* driver, and emulates and is compatible with nearly any application that supports the Microsoft Mouse. An especially nice touch is the MENU feature that allows you to build pop-up menus with ease.

Looking for a reliable, reasonably priced mouse with few frills? Check out the Dell Serial Mouse. This one will get you pointing and clicking without busting your budget.

Dell Serial Mouse
Dell Computer Corp., 9505 Arboretum Blvd., Austin, TX 78720; (800) 426-5150, (512) 338-4400.
List Price: $59.95.

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•DMS-200H Mouse

by Bruce Brown

DFI's two mice are actually two generations of the same product. The DMS-200H Mouse is a newer version of the DMS-200, but both are currently available. These $79.95, 9-pin serial mice are Microsoft Mouse- and Mouse Systems-compatible. The 200H model includes more and does more than the 200. The 200H is also available with a 25-pin serial plug for the same price.

The DMS-200 Mouse is a serial, optomechanical, three-button mouse with a 71-inch cord. The mouse's ⅞-inch silicon rubber ball is removable for cleaning and comes with a 7.5-by-9-inch pad. The pad can be used as a cutting pad and has both inch and centimeter scales. The newer DMS-200H has a user-defined default compatibility switch, allows ballistic tracking ranging from 5 to 700 ppi, and also includes a convenient mouse pocket that attaches to the side of your monitor.

Even though the packages for the two mice indicate differently, both versions of the mouse come with the same software. DFI includes both CONFIG.SYS and DOS command-line mouse drivers.

Other standard software includes a mouse diagnostic program, DFI's *MenuScript*, and *BitPaint*. *MenuScript* is a programming language used to create utility programs allowing mouse use with application programs that support mice. Prewritten *MenuScript* programs are included for many popular keyboard-based programs.

BitPaint is a graphics paint program that can be used with several Fax modem boards to send graphic files to Group III Fax machines.

If you're looking for a pointing device that gives plenty of software support at a reasonable price, the DFI mouse is a fine buy. But look for the newer DMS-200H—it's an even better deal.

DMS-200 Mouse
DMS-200H Mouse
DFI Inc., 2544 Port St., W. Sacramento, CA 95691; (916) 373-1234.
List Price: DMS-200 Mouse, $79.95; DMS-200H Mouse, $79.95.

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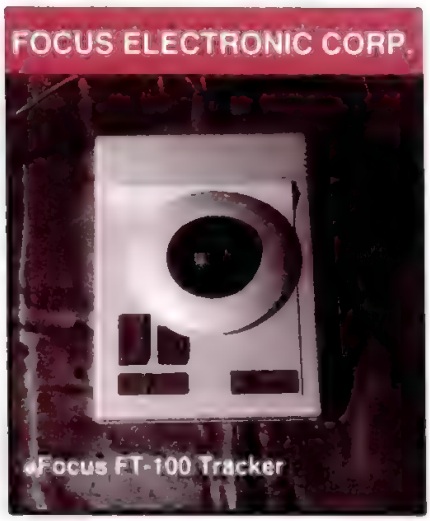

•Focus FT-100 Tracker

by John R. Quain

The main business for Focus is keyboards. So it's not surprising that its alternate input device, the FT-100 Tracker, is a large, stationary, three-button trackball.

For the low price of $65, the 160-ppi

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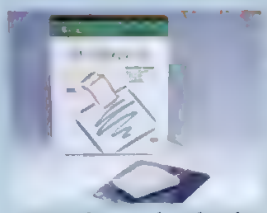

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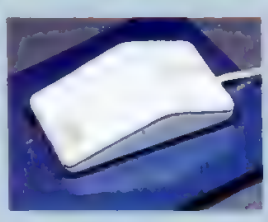

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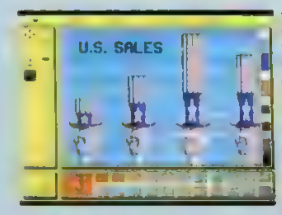

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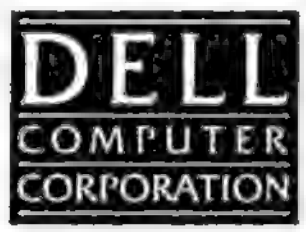

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190 MB Super VGA Color System (800 x 600)	$4,099	$800

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The Dell System 325 25 MHz 386

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40 MB VGA Monochrome System	$3,999	$600
80 MB VGA Color Plus System	$4,499	$700
190 MB Super VGA Color System (800 x 600)	$5,099	$900
330 MB Super VGA Color System (800 x 600)	$5,899	$1,000

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Prices listed include 4 MB of RAM.* 100 MB hard drive configurations also available.

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AD CODE HB71

CIRCLE 527 ON READER SERVICE CARD

serial Tracker includes a pop-up test menu that allows you to change a number of parameters including the COM port, baud rate, and cursor shape. Its Microsoft Mouse compatibility allows it to easily substitute for the small white rodent on software such as *Microsoft Windows*, and the Mouse Systems emulation gets it up and running on others, such as *PC Paintbrush* (Z-Soft Corp.). A switch on the front of the Tracker enables you to toggle between the two emulations. By inserting TRACKER in your AUTOEXEC.BAT file, you can use the Focus driver for programs like *Norton Commander* (Peter Norton Computing) and *Multiplan* (Microsoft Corp.).

Installing the Tracker was relatively trouble free, although the documentation was scant. Moreover, when I plugged in the connection to the trackball itself, the case popped open. This was not by design. A screw was missing (the same screw you'd remove if you wanted to clean the trackball).

In terms of palms-on operation, the missing screw meant that the optomechanical sensor didn't always accurately read the ball's movements, although when it was operating properly, the Tracker managed to move the cursor smoothly across the screen. After a while, however, I found that the Tracker's buttons required more pressure than was comfortable for long-term use. And the placement of the three buttons in relation to the ball made it difficult to work the controls in concert.

Overall, "focus" was what we found lacking here. Furthermore, the Tracker's shortcomings were exacerbated by what we felt was unresponsive technical support. And the last thing you want is an unresponsive cursor sitting on your screen.

Focus FT-100 Tracker
Focus Electronic Corp., 9080 Telstar Ave., Suites 302-304, El Monte, CA 91731; (800) 888-6676, (818) 280-0416.
List Price: $65.
CIRCLE 617 ON READER SERVICE CARD

MICE AND TRACKBALLS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Antec Inc. **Artec Mouse AM-21 Plus**	CalComp Inc. **CalComp Wiz Mouse System**	Chicony America Inc. **Chicony Keyboard KB-5581**	CH Products Inc. **RollerMouse**	CMS Enhancements Inc. **CMS Mini Mouse** (Standard)	CMS Enhancements Inc. **CMS Mini Mouse** (Hi-res)	Commax Inc **Witty Mouse** (not reviewed)	Commax Inc. **Fancy Mouse**
List price	$35	$199	$99	$129.95/$149.95*	$99.95/$109.95*	$129.95/$149.95*	$35	$45
HARDWARE FEATURES								
Type of device	Mouse	Mouse	Keyboard with built-in trackball	Trackball	Mouse	Mouse	Mouse	Mouse
Manufacturer	Artec	CalComp	Chicony America	CH Products	Information not available	Information not available	Commax	Commax
Interfaces supported	Serial	Serial, PDP	Serial	Serial, bus, PS/2	Serial, bus	Serial, bus	Serial	Serial
IRQs supported	3, 4	2, 3, 4, 5	4	3, 4	2, 3, 4, 5	2, 3, 4, 5	0, 3, 7, 8	0, 3, 7, 8
Base (hardware) resolution (ppi)	356	1,000	200	100, 200, 400	250	340	360	360
Number of buttons	3	6	3	4	3	3	3	3
Position sensor used	Optomechanical	Electromagnetic	Mechanical	Optomechanical	Mechanical	Mechanical	Optomechanical	Optomechanical
Mouse pad included	■	■	N/A	N/A	N/A	N/A	❑	■
Ball removable for cleaning	■	N/A	❑	■	■	■	■	■
Warranty	Five year parts and labor	Five year parts and labor	One year parts and labor	One year parts and labor	Lifetime parts and labor	Lifetime parts and labor	One year parts and labor	One year parts and labor
Cord length (inches)	81	32	81	60	71	71	62.25	62.25
Weight of device only (lbs.)	0.25	0.17	3.41	0.8	0.25	0.25	0.22	0.22
SOFTWARE FEATURES								
Number of bytes in CONFIG.SYS device driver	4,927	N/A	12,242	10,976	10,768	10,768	N/A	N/A
Number of bytes in command line driver	N/A	30,720	12,366	10,496	10,288	10,288	19,526	19,526
Disk format of supplied driver	5.25	5.25, 3.5	5.25	5.25	5.25	5.25	5.25	5.25
Version of tested driver	1.01	1.0.1.1	1.0	6.24A	6.11	6.11	4.1	4.1
Driver can be uninstalled from DOS	N/A	■	■	■	■	■	■	■
Ballistic tracking supported	❑	❑	❑	■	❑	❑	■	■
Minimum resolution supported	N/A	N/A	N/A	1	N/A	N/A	360	360
Maximum resolution supported	N/A	N/A	N/A	2,880	N/A	N/A	1,050	1,050
Driver upgrades available	❑	■	■	■	■	■	■	■
Other mouse emulations included	Microsoft, Mouse Systems	❑	Microsoft, Mouse Systems	Microsoft	Mouse Systems	Mouse Systems	Microsoft, Mouse Systems	Microsoft, Mouse Systems
Supports Microsoft Mouse driver in *Microsoft Windows*	■	■	■	■	■	■	■	■
Mouse driver supports interrupt 33	■	■	■	■	■	■	■	■
Driver for *Microsoft Windows* included	❑	■	❑	■	❑	❑	■	■
Driver for *AutoCAD* included	❑	■	❑	■	❑	❑	■	■

—Editor's Choice ■—Yes ❑—No
N/A —Not applicable: the product does not have this feature.
*Where two list prices are given, the first is a serial, PS/2, or InPort version. The second is the bus version except in the case of the Genius Mouse GM-F302/F303 and the Series 9 mouse, whose prices are clarified in the fact files.

FULCRUM COMPUTER PRODUCTS CO.

by Rink Murray

Fulcrum Computer Products' Trackball Plus is a six-button, cursor-control device that supports eight different emulations. And at $89, the Trackball Plus maintains the bargain status we gave it when it was last reviewed in our August 1987 issue ("Trackballs: Stationary Mice").

It also shows some of the same problems. First, it needs its own 120-volt power supply, so you'd better have an extra outlet handy and be willing to put up with yet another cable on your desk. And while the DOS-based installation procedure is simple in theory, the lack of clearly organized, step-by-step documentation makes it otherwise.

However, after your initial struggle, you'll find using the Trackball Plus to be a pleasant experience. In addition to the Microsoft Mouse emulation, the Trackball Plus emulates seven other devices, including a Summagraphics Bit-Pad digitizing tablet.

There are two ways to move from one mode to another. You can install drivers at the DOS prompt or, as long as you have the correct driver installed, simply press the 1, 2, 3, and 5 keys simultaneously, followed by the keys corresponding to the mode you desire.

The Trackball Plus' six buttons are la-

Commax Inc. **Witty Ball** $78	Dell Computer Corp. **Dell Serial Mouse** $59.95	DFI Inc. **DMS-200 Mouse** $79.95	Electronic DFI Inc. **DMS-200H Mouse** $79.95	Focus Fulcrum Corp. **Focus FT-100 Tracker** $65	Computer Products Co. **Trackball Plus** $89	International IBM Corp. **IBM/PS/2 Mouse** $99	International Machine Control Systems **The MousePen** $129	International Machine Control Systems **The MousePen** $129	Microcomputer Software Inc. **IMSI Mouse** $99.95/$109.95*
Trackball	Mouse	Mouse	Mouse	Trackball	Trackball	Mouse	Mouse	Mouse	Mouse
Commax	Logitech	DFI	DFI	Focus	Fulcrum	Alps	IMCS	IMCS	Z-Nix
Serial	Serial	Serial	Serial	Serial	Serial	PS/2	Serial	PS/2	Serial, bus
0, 3, 7, 8	4	3, 4	3, 4	1, 2	1, 2	12	0, 3, 4	0, 3, 4	4
300	200	200	200	160	100	200	100	100	250
3	2	3	3	3	6	2	2	2	2
Optomechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical	Mechanical	Optomechanical	Optomechanical	Mechanical
N/A	N/A	■	■	N/A	N/A	N/A	N/A	N/A	N/A
❑	■	■	■	■	❑	■	■	■	■
One year parts and labor	One year parts and labor	One year parts and labor	One year parts and labor	One year parts and labor	Six month parts and labor	One year parts and labor	Unconditonal one year parts and labor, lifetime afterward	Unconditonal one year parts and labor, lifetime afterward	Lifetime parts and labor
62	72	71	71	59.5	48	108	118	118	69
0.52	0.19	0.24	0.24	0.75	0.86	0.11	0.06	0.06	0.25
N/A	14,336	15,657	15,657	817,152	11,120	N/A	10,960	10,496	10,544
19,526	14,336	15,569	15,569	272,384	16,888	10,384	10,480	10,000	9,952
5.25	5.25 and 3.5	5.25	5.25	5.14	5.25, 3.5	3.5	5.25, 3.5	5.25, 3.5	5.25
4.1	3.43	3.0	3.0	1.02	6.24B	1.1	6.24A	6.24A	6.11
■	■	❑	❑	■	■	❑	■	■	❑
❑	❑	❑	■	■	■	❑	■	■	❑
N/A	N/A	N/A	5	160	100	N/A	50	50	N/A
N/A	N/A	N/A	700	500	25,000	N/A	1,000	1,000	N/A
■	■	■	■	❑	■	❑	■	■	■
Microsoft, Mouse Systems	Microsoft	Microsoft, Mouse Systems	Microsoft, Mouse Systems	Microsoft, Mouse Systems	Microsoft, Mouse Systems	❑	Microsoft	Microsoft	Microsoft
■	■	■	■	■	■	■	■	■	■
■	❑	■	■	■	■	■	■	■	■
■	■	❑	❑	❑	❑	❑	❑	❑	❑
■	■	❑	❑	❑	❑	❑	❑	❑	❑

CONTINUES

beled 1, 2, 3, 4, A, and 5. The A key functions as an Alternate Cursor key for use in CAD programs, allowing you to put two cursors on-screen. If you need to drag something across the screen simply push button 4, and the next button you press will lock until your next click.

Included with the Trackball Plus are two menuing programs. The first lets you create your own menu templates. The other nifty program is *Point-N-Shoot*, a memory-resident windowing program that makes keystroke commands virtually obsolete in many popular applications such as *Lotus 1-2-3*, *WordPerfect*, *dBASE*, and many more.

The Trackball Plus is an optomechanical device, so there are few breakable parts. Resolution is a modest 100 dpi, but scrolling is only the slightest bit jumpy.

The Trackball Plus is and has been a solid performer, but look for the new Fulcrum trackball due out about the same time as this article. With higher resolution and self-installation promised, this good thing will only get better.

Trackball Plus
Fulcrum Computer Products Co., 459 Allan Ct., Healdsburg, CA 95448; (707) 433-0202.
List Price: $89.
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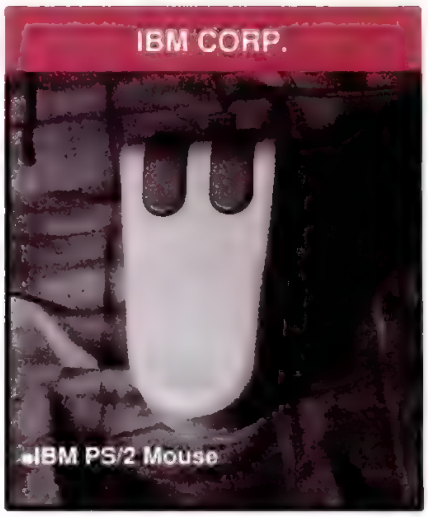

MICE AND TRACKBALLS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	ITAC Systems Inc. **Mouse-Trak**	ITAC Systems Inc. **Mouse-Trak**	Kensington Microware Ltd. **Kensington Expert Mouse**	Key Tronic Corp. **Key Tronic Professional Series Mouse**	Kraft Systems Inc. **Kraft Trackball**	KYE International Corp. **Genius Mouse GM-6X**	KYE International Corp. **Genius Mouse GM-6000**	KYE International Corp **Genius Mouse GM-F302/F303**
List price	$169/$195*	$179/$199*	$169.95	$109	$129.95	$49	$79	$99/$109*
HARDWARE FEATURES								
Type of device	Trackball	Trackball	Trackball	Mouse	Trackball	Mouse	Mouse	Mouse
Manufacturer	ITAC Systems	ITAC Systems	Kensington Microware	Key Tronic	Kraft Systems	KYE International	KYE International	KYE International
Interfaces supported	Serial, bus PS/2, InPort	Serial, bus PS/2, InPort	PS/2	Serial, bus	Serial	Serial	Serial	Serial, PS/2
IRQs supported	3, 4, 5, 7, 10, 11, 12, 15	3, 4	2, 3, 4, 5, 7, 10, 11, 12, 15	2, 3, 4, 5	3, 4	1, 2, 3, 4, 5	1, 2, 3, 4, 5	1, 2, 3, 4, 5
Base (hardware) resolution (ppi)	200	200	200	200	200	200	350	350
Number of buttons	2	3	2	2	3	3	3	3
Position sensor used	Optomechanical	Optomechanical	Optomechanical	Mechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical
Mouse pad included	N/A	N/A	N/A	❑	N/A	❑	■	■
Ball removable for cleaning	■	■	■	■	■	■	■	■
Warranty	One year parts and labor	One year parts and labor	One year parts and labor	One year limited	Five year parts and labor	Lifetime parts and labor	Lifetime parts and labor	Lifetime parts and labor
Cord length (inches)	60	60	72	58	96	70	71	70
Weight of device only (lbs.)	0.94	0.94	0.89	0.32	0.75	0.26	0.26	0.87
SOFTWARE FEATURES								
Number of bytes in CONFIG.SYS device driver	11,000	11,000	15,392	10,688	11,887	N/A	13,083	13,659
Number of bytes in command line driver	10,000	10,000	20,894	10,224	13,525	12,649	13,664	13,664
Disk format of supplied driver	5.25	5.25	5.25, 3.5	5.25	5.25	5.25	5.25	5.25
Version of tested driver	6.11	6.11	2.03	1.1	1.06	8.20	9.03	9.03
Driver can be uninstalled from DOS	■	■	■	❑	■	■	■	■
Ballistic tracking supported	■ (bus only)	■ (bus only)	■	❑	❑	■	■	■
Minimum resolution supported	20	20	20	N/A	10**	50	87.5	87.5
Maximum resolution supported	800	800	10,000	N/A	1,150**	800	1,400	1,400
Driver upgrades available	■	■	■	■	■	■	■	■
Other mouse emulations included	Microsoft, Mouse Systems	Microsoft, Mouse Systems	Microsoft, IBM PS/2	Microsoft	❑	Microsoft, Mouse Systems	Microsoft, Mouse Systems	Microsoft, Mouse Systems
Supports Microsoft Mouse driver in *Microsoft Windows*	■	■	■	■	■	■	■	■
Mouse driver supports interrupt 33	■	■	■	■	■	■	■	■
Driver for *Microsoft Windows* included	❑	❑	■	❑	❑	❑	❑	❑
Driver for *AutoCAD* included	❑	❑	❑	❑	■	❑	❑	❑

—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.
*Where two list prices are given, the first is a serial, PS/2, or InPort version. The second is the bus version except in the case of the Genius Mouse GM-F302/F303 and the Series 9 mouse, whose prices are clarified in the fact files.
**The product features adjustable resolution, but not ballistic tracking.

by Mary Kathleen Flynn

When IBM launched the PS/2 line, the company also introduced its first mouse. Today, three and a half years later, IBM is still selling the same old rodent. Just about the only thing that's changed is the price—and that just barely. At a list price of $99, the PS/2 Mouse costs only $4 more than it did when we reviewed it in the August 1987 issue of *PC Magazine*. Although Big Blue's mouse is a bit old, it's still stealing cheese.

The PS/2 Mouse sports a basic two-button mechanical design, manufactured for IBM by Alps. Put it beside Microsoft's "Dove bar," and the PS/2 Mouse looks—and feels—its age.

The only interface the PS/2 Mouse supports is the Pointing Device Port (PDP), which made its debut in the original PS/2s and provides support for the mouse on the motherboard. The PS/2 Mouse's base resolution is only 200 ppi—lower than most of the heavy-hitting competition but adequate for many of today's applications and display systems. And, its features set is rather small. If you are seeking such modern amenities as ballistic tracking, bundled applications, and menu generators, you should look elsewhere.

But simplicity has its rewards. Compared with Microsoft's feature-laden

It may not be fancy, but IBM's plain little PS/2 Mouse has managed to nibble off 10 percent of the retail market, putting IBM in third place behind Microsoft and Logitech.

Liuski International **ProCorp Mouse** $89	Liuski International **ProCorp Mouse** $89	Logitech Inc. **Series 9 Mouse** $119/$139	Logitech Inc. **Series 9 Mouse** $119/$149	Logitech Inc. **TrackMan Stationary Mouse** $139/$149	Logitech Inc. **Dexxa Mouse** $69	Lynx Computer Products Inc. **Lynx Turbo Trackball** $129.95	Marconi Circuit Technology Corp. **Marconi Marcus RB2-305/306** $145	Microsoft Corp. **Microsoft Mouse** $125	MicroSpeed Inc. **PC-Trac** $119/$139
Mouse	Mouse	Mouse	Mouse	Trackball	Mouse	Trackball	Trackball	Mouse	Trackball
P.R.O. Corp.	P.R.O. Corp.	Logitech	Logitech	Logitech	Logitech	Lynx	Marconi	Alps	MicroSpeed
Serial	Bus	Serial, bus	PS/2, PS/2 and serial	Serial, bus	Serial, bus	Serial, bus, PS/2	Serial, bus	Serial, bus, PS/2, InPort	Serial, bus, PS/2, InPort
3, 4	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5	2, 3, 4, 5, 7
250	340	320	400	320	200	250	76	400	200
3	3	3	3	3	2	2	3	2	3
Mechanical	Mechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical	Mechanical	Optomechanical	Mechanical	Optomechanical
■	■	❑	❑	N/A	■	N/A	N/A	❑	N/A
■	■	■	■	■	■	■	❑	■	■
One year parts and labor	One year parts and labor	Limited lifetime	Limited lifetime	Limited lifetime	Limited lifetime	Lifetime replacement	One year parts and labor	One year parts and labor	One year parts and labor
70	69.75	108	108	108	72	72	45.75	104	67
0.27	0.27	0.22	0.22	0.5	0.16	0.5	1.3	0.28	0.75
10,768	10,768	14,336	14,336	14,336	13,312	10,544	3,163	14,336	18,055
10,288	10,288	14,336	14,336	14,336	13,312	9,952	13,119	14,336	17,911
5.25	5.25	5.25, 3.5	5.25, 3.5	5.25, 3.5	5.25	5.25	5.25, 3.5	5.25, 3.5	5.25 or 3.5
6.11	6.11	4.10	4.10	4.10	3.43	6.11	6.21	7.04	2.1
■	■	■	■	■	❑	■	■	■	❑
❑	❑	■	■	■	■	■	■	■	■
N/A	N/A	50	50	50	50	50	10	0	50
N/A	N/A	19,000	19,000	15,000	750	950	76	Infinite	1,000
■	■	■	■	■	■	■	■	■	■
❑	❑	Microsoft, Mouse Systems	Microsoft, Mouse Systems	Microsoft, Mouse Systems	❑	❑	Microsoft	❑	Microsoft, Mouse Systems
■	■	❑	❑	■	❑	■	■	■	■
■	■	■	■	■	■	■	■	■	■
■	■	❑	❑	❑	❑	❑	■	■	■
■	■	❑	❑	❑	❑	❑	■	❑	■

CONTINUES

File Edit Gallery Chart
Format Macro Window Help
File Edit View Show Alarm Options
Format Macro Window Help
TOSHIBA
T3100SX

The ultimate portable for the ultimate program.

Since the T3100SX is battery operated, you can use powerful 386 applications wherever you choose.

Toshiba has combined the ultimate battery-operated portable, the T3100SX, with the ultimate program, Microsoft® Windows™ 3.0, to create the ultimate work environment.

The T3100SX gives you everything you need to get down to business. Including the brute strength of the 386SX™ microprocessor. And there's no better screen in a portable. It has a brilliant 640 x 480 VGA gas plasma display and a 100:1 contrast ratio.

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T3100SX: 12.2 pounds (without batteries), 14.9 pounds (with batteries). 16MHz 386SX with 80387SX math co-processor socket, 40 or 80 MB hard disk with 25msec access, two removable, rechargeable batteries; three dedicated Toshiba memory slots, one dedicated Toshiba modem slot, one Toshiba general purpose slot, simultaneous display, 1MB RAM expandable to 13MB, gas plasma VGA display with 16 gray scales and 100:1 contrast ratio; 1.44 MB 3½" diskette drive. Microsoft is a registered trademark and Windows is a trademark of Microsoft Corporation. 386 and SX are trademarks of Intel Corporation.

For more information call (800) 457-7777, Dept. W

In Touch with Tomorrow

TOSHIBA

CIRCLE 379 ON READER SERVICE CARD

Toshiba America Information Systems Inc., Computer Systems Division

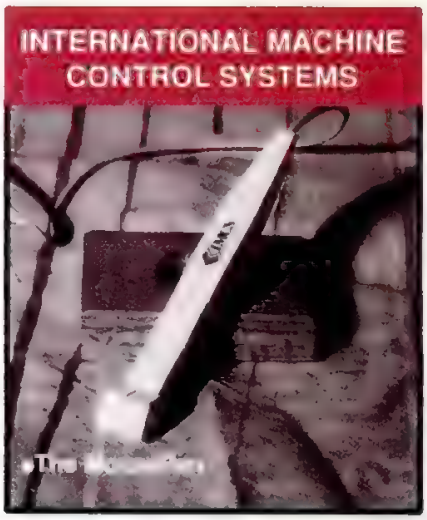
26,000-byte driver, IBM's command-line driver is a mere 8,000 bytes. (Unfortunately, you can't uninstall it from DOS.) In *Microsoft Windows*, you can choose either the IBM driver or the Microsoft Mouse driver.

The lack of features also means IBM can get away with the skimpy pamphlet it masquerades as documentation. If you've still got your PS/2 manual, however, you can supplement the pamphlet with some information included there. Fortunately, the PS/2 Mouse does come equipped with a couple of convenient features. At 9 feet, the cord is about the longest you'll find. And, as is the case with the ball in the Microsoft Mouse, the ball in the PS/2 Mouse can be easily removed for cleaning.

It may not be fancy, but the PS/2 Mouse has done quite well for Big Blue. Sold mostly with systems through dealers, this plain little mouse has managed to nibble off 10 percent of the retail market, putting IBM in third place behind Microsoft and Logitech, according to Microsoft. As long as IBM keeps selling PS/2s, the PS/2 Mouse has a secure future.

IBM PS/2 Mouse
IBM Corp., contact your nearest authorized IBM dealer; (800) IBM-2468.
List Price: $99.

CIRCLE 619 ON READER SERVICE CARD



MICE AND TRACKBALLS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	MicroSpeed Inc. **FastTRAP**	Mouse Systems Corp. **PC Mouse**	Mouse Systems Corp. **PC Mouse III**	Mouse Systems Corp. **OmniMouse II**	Mouse Systems Corp. **The White Mouse**	Mouse Systems Corp. **PC Trackball**	Numonics Corp. **Manager Mouse Cordless**	Penny + Giles Controls Inc. **TrackerMouse/ TM1**
List price	$149/$169*	$149	$149/$169*	$79.95/$99.95*	$99.95/$119.95*	$119.95/$139.95*	$175	$99
HARDWARE FEATURES								
Type of device	Trackball	Mouse	Mouse	Mouse	Mouse	Trackball	Mouse	Trackball
Manufacturer	MicroSpeed	Mouse Systems	Mouse Systems	Mouse Systems	Mouse Systems	Mouse Systems	Numonics	Penny + Giles Computer Products
Interfaces supported	Serial, bus	Serial, bus, PS/2	Serial, bus, PS/2	Serial, bus	Serial, bus, PS/2	Serial, PS/2	Serial	Serial, PS/2
IRQs supported	2, 3, 4, 5, 7	2, 3, 4, 5, 7	2, 3, 4, 5, 7	2, 3, 4, 5, 7	2, 3, 4, 5, 7	2, 3, 4, 5, 7	1, 2, 3, 4	3, 4
Base (hardware) resolution (ppi)	200	100	300	200	350	200	200	40
Number of buttons	3	3	3	2	3	3	3	2
Position sensor used	Optomechanical	Optical	Optical	Optomechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical
Mouse pad included	N/A	■	■	❑	■	N/A	❑	N/A
Ball removable for cleaning	■	N/A	N/A	■	■	■	❑	■
Warranty	One year parts and labor	Lifetime parts and labor	Lifetime parts and labor	Lifetime parts and labor	Lifetime parts and labor	Lifetime parts and labor	One year parts and labor	One year parts and labor
Cord length (inches)	69	58.5	96	69	69	75	80.5	53
Weight of device only (lbs.)	0.82	0.18	0.17	0.18	0.24	0.52	0.24	0.53
SOFTWARE FEATURES								
Number of bytes in CONFIG.SYS device driver	17,378	12,288	12,288	12,288	12,288	12,288	12,288	12,801
Number of bytes in command line driver	17,234	17,408	18,432	17,408	17,408	17,408	12,288	14,240
Disk format of supplied driver	5.25	5.25	5.25, 3.5	5.25	5.25, 3.5	5.25	5.25	5.25, 3.5
Version of tested driver	2.06A	6.23	7.0	6.23	6.23	6.23	2.06	3.1
Driver can be uninstalled from DOS	❑	■	■	■	■	■	■	❑
Ballistic tracking supported	■	■	■	■	■	■	■	■
Minimum resolution supported	50	20	30	20	20	20	50	40
Maximum resolution supported	1,000	11,200	30,000	11,200	11,200	11,200	1,000	400
Driver upgrades available	■	■	■	■	■	■	■	■
Other mouse emulations included	Microsoft, Mouse Systems	Mouse Systems, IBM PS/2	Microsoft, Mouse Systems, IBM PS/2	Microsoft	Microsoft, Mouse Systems, IBM PS/2	Microsoft	Microsoft, Mouse Systems	❑
Supports Microsoft Mouse driver in *Microsoft Windows*	■	❑	■	■	■	■	❑	■
Mouse driver supports interrupt 33	■	■	■	■	■	■	■	■
Driver for *Microsoft Windows* included	■	■	■	❑	❑	❑	❑	■
Driver for *AutoCAD* included	■	❑	❑	❑	❑	❑	❑	■

❑—Editor's Choice ■—Yes ❑—No
N/A—Not applicable: the product does not have this feature.
*Where two list prices are given, the first is a serial, PS/2, or InPort version. The second is the bus version except in the case of the Genius Mouse GM-F302/F303 and the Series 9 mouse, whose prices are clarified in the fact files.

by Ed Perratore

Many people are content to stick with the accepted mouse design for the usual point-and-click operations. But if your needs take you into specialized applications like CAD, desktop publishing or freehand drawing, the "Dove bar" mouse as a precision tool may frustrate you. If so, consider the MousePen from International Machine Control Systems.

The idea behind the $129 product is that we use a pen long before we use a mouse. You hold the MousePen angled against a surface and click its buttons as needed. Its ball is activated by friction. The advantage? It can be used on any surface, level or not: your desktop, a wall, even your knee.

Seasoned mousers will find it takes some getting used to. Initially, for instance, it's easy to tip the unit and let the ball lose touch with your work surface. But for overall detail work, the MousePen may be just the ticket. Its resolution ranges from a steady 50 ppi to a responsive 1,000 ppi through sophisticated ballistic tracking.

IMCS provides 100 percent Microsoft-compatible drivers for serial and PS/2 hookups; they also include an adapter that will convert the MousePen's mouse-port jack to suit 9- and 15-pin serial ports.

The company also offers an attractive warranty—it will replace the product unconditionally during the first year. Later, IMCS will replace it if necessary for a mere $20. Driver upgrades are free; they will upload them to you via modem or, for a handling charge, mail you a disk.

This product does not pretend to win out in ordinary point-and-click tasks. But if your needs are more specialized and the basic mouse doesn't cut it, the MousePen is an attractive alternative.

The MousePen

International Machine Control Systems (IMCS), 1332 Vendels Circle, Paso Robles, CA 93446; (800) 448-1184 (outside CA), (805) 239-8976 (inside CA).

List Price: $129.

CIRCLE 620 ON READER SERVICE CARD

Penny + Giles Controls Inc **TrackerMouse/ TM1 Plus 16** $219	Penny + Giles Controls Inc **TrackerMouse/ TM1 Plus 32** $249	Practical Solutions Inc. **The Cordless Mouse** $149.95	ProHance Technologies Inc. **ProHance PowerMouse 100** $249	Qualitas Trading Co **Samurai Mouse** $59.95	SmarTEAM Inc. **SmarTEAM Mouse** $75	Suncom Technologies **SunMouse** $59 99	Suncom Technologies **MouseTrac** $99 95	Tandy Corp **Tandy Serial Mouse** $49.95	Tandy Corp. **Tandy 2-Button Mouse** $49.95
Trackball	Trackball	Mouse	Programmable mouse	Mouse	Mouse	Mouse	Trackball	Mouse	Mouse
Penny + Giles Computer Products	Penny + Giles Computer Products	Information not available	ProHance Technologies	NEOS Electronics	TEAM Technology	Information not available	Information not available	Tandy	Tandy
Serial	Serial, PS/2	Serial, PS/2	Serial	Serial	Serial, bus	Serial	Serial	Serial	PS/2
3, 4	3, 4	3, 4	All	3, 4	None	3, 4	3, 4	3, 4	0
40	40	200	200	200	250	200	200	200	200
16	32	3	40	2	3	3	3	2	2
Optomechanical	Optomechanical	Optomechanical	Optomechanical	Optomechanical	Mechanical	Optomechanical	Optomechanical	Mechanical	Optomechanical
N/A	N/A	❑	❑	❑	❑	❑	N/A	❑	❑
■	■	■	■	■	■	■	■	■	■
One year parts and labor	One year parts and labor	One year parts and labor	One year parts and labor	One year parts and labor	Limited lifetime	One year parts and labor	One year parts and labor	90 day replacement	90 day replacement
53	53	N/A	70	58	70	56	104	60	62
0.6	0.6	0.27	0.44	0.27	0.26	0.28	0.70	0.22	0.20
12,801	12,801	N/A	N/A	16,976	10,704	N/A	N/A	13,793	13,793
14,240	14,240	11,289	15,913	16,784	10,224	N/A	N/A	13,950	13,950
5.25, 3.5	5.25, 3.5	5.25, 3.5	5.25, 3.5	5.25	5.25	N/A	N/A	5.25, 3.5	5.25, 3.5
3.1	3.1	4.2	5.23	4.0	6.11	N/A	N/A	6.10	6.10
❑	❑	❑	■	■	■	N/A	❑	❑	
■	■	■	■	■	❑	❑	❑	■	■
40	40	10	200	100	N/A	N/A	N/A	200	200
400	400	1,200	400	1,000	N/A	N/A	N/A	19,000	19,000
■	■	■	■	❑	■	N/A	N/A	❑	❑
❑	❑	Mouse Systems	■	Microsoft	Microsoft	N/A	N/A	Microsoft	Microsoft
■	■	■	❑	■	■	■	■	■	■
■	■	■	■	■	■	N/A	N/A	■	■
■	■	■	■	❑	❑	❑	❑	❑	❑
■	■	■	❑	❑	❑	❑	❑	❑	❑

ENDS

INTERNATIONAL MICRO-COMPUTER SOFTWARE INC.

•IMSI Mouse

by Robert Kendall

IMSI offers its mouse in a $99.95 serial version and $109.95 bus version. The company also markets the IMSI Opti-Mouse for $149.95, which is an OEMed version of MSC's optical PC Mouse.

The two versions of the IMSI Mouse are functionally identical, except that the bus mouse allows jumper selection of IRQs 2 to 5. Both come with predefined TSR mouse menus for DOS; *Lotus 1-2-3; WordPerfect*, Versions 4.0 through 4.2; and *dBASE III Plus*. You also get a programming language and compiler for writing your own context-sensitive pop-up mouse menus.

IMSI offers several bundling options: Add $10 for *Dr. Halo III* (from Media Cybernetics Inc.) or *Pipe Dreams* (a mouse-driven game from Lucas Films), $30 for *TurboCAD* (by Milan Systems America Inc.), and $50 for *PFS:First Publisher* (from Software Publishing Corp.).

Unfortunately, the IMSI Mouse lacks the advanced features of many competitors. Its base resolution is only 250 ppi, and the device uses mechanical position sensors rather than the more durable opto-mechanical variety. The driver lets you adjust horizontal and vertical sensitivity, but not within an application. The software allows only dual-rate tracking (the rate doubles at a user-specified speed threshold)—a far cry from true ballistic tracking.

The bus version of the mouse displayed a tendency to wobble slightly on the desktop. This defect was also present in a replacement unit provided by the vendor, but was absent from the serial version.

On the positive side, installation is fully automated and menu driven, the mouse passed our compatibility tests, and it comes with a lifetime warranty. IMSI offers a solid product with strong programming and application support, but you may want to opt for a mouse with a similar price and more features.

IMSI Mouse
International Microcomputer Software Inc. (IMSI), 1299 Fourth St., San Rafael, CA 94901; (800) 833-4674, (415) 454-7101.
List Price: Serial version, $99.95; bus version, $109.95.
CIRCLE 621 ON READER SERVICE CARD

ITAC SYSTEMS INC.

•Mouse-Trak

by Oliver Rist

The three-button, optomechanical Mouse-Trak trackball is ITAC Systems' first entry into the personal computer market. Designed for tough industrial, military, and scientific environments, the $179 serial Mouse-Trak ($199 for the bus version and $169 and $195, respectively, for the two-button serial and bus models) is aimed at high-end power users who want precision and stability. And the boxy Mouse-Trak is decidedly stable; I stood on mine—at the vendor's urging—and it didn't even squeak. ITAC claims to be testing a new waterproof version, too (for some reason they're running a car over this one). ITAC manufactures Mouse-Traks that support other platforms as well, including Amiga, Atari, Apple, and more.

Software accompanying the Mouse-Trak is sparse. A proprietary pop-up menu program, MENUKEY, can be requested for free, but only the device drivers and self-test programs come standard. There are no other bundling options.

Both models support adjustable resolution from 20 to 800 ppi, but only the bus models support ballistic tracking. Both also have a face-mounted speed selector switch that slows the pointer for detail work. This function proved extremely useful in typical *Windows* applications. The bus model supported *Windows* in its default configuration, but the serial version had to be modified by changing from 5-byte to 3-byte mode via a slide switch and reinstalling under MSOFTRAK.SYS—a procedure not clearly presented in the manual.

Both versions also support alternate action (click to start a function and click again to turn it off) and the standard momentary action. The three-button models can convert as well to a two-button mode.

Installation was confusing because the serial version came with an out-of-date generic manual and the bus model came with the new serial documentation. Even with this obstacle, however, experienced users will find only minor setup difficulties. There are two-button and three-button Mouse-Trak models that support PS/2 and InPort connections in both bus and serial modes. Just plug them in, call up the device drivers, and click away.

Although a bit software-thin for low-end consumers, Mouse-Trak is a well-designed, smoothly precise input device that can serve the power user well.

Mouse-Trak
ITAC Systems Inc., 3121 Benton St., Garland, TX 75042; (800) 533-ITAC, (214) 494-3073.
List Price: Three-button serial, $179; three-button bus, $199; two-button serial, $169; two-button bus, $195.
CIRCLE 622 ON READER SERVICE CARD

KENSINGTON MICROWARE LTD.

•Kensington Expert Mouse

by Robert Kendall

Though it goes by the name of Expert Mouse, Kensington Microware's sole al-

Other laser printers play with one standard dot size.

HP makes it a

ASTRONOMY IS LOOKING UP

THE HIRSCH REPORT OF THE SKIES VOL. 8, NO. 4, FALL 1990

Reported by The Star

Every day billions of dust particles enter into Earth's atmosphere. Now scientists are working to make meteor-burst communication a practical and economical alternative to the use of tele-

(continued on page 3)

You Can't See the Great Wall from the Moon!

Everyone has heard that you can see the Great Wall of China from the Moon. Or from Earth orbit. Or even from Mars. Certainly you cannot see the Great Wall from the Moon. According to an astronaut, it's difficult even seeing continents. You may be able to see the Great Wall from orbit, but, in general, it's difficult even to see familiar objects; the planet's swift mo-

(continued on page 3)

More on planetary explosions inside.

Voyager's Last Picture Show: When Voyager 2 was launched 12 years ago, who could have imagined these photos at this point in time.

NO BLACK HOLES?

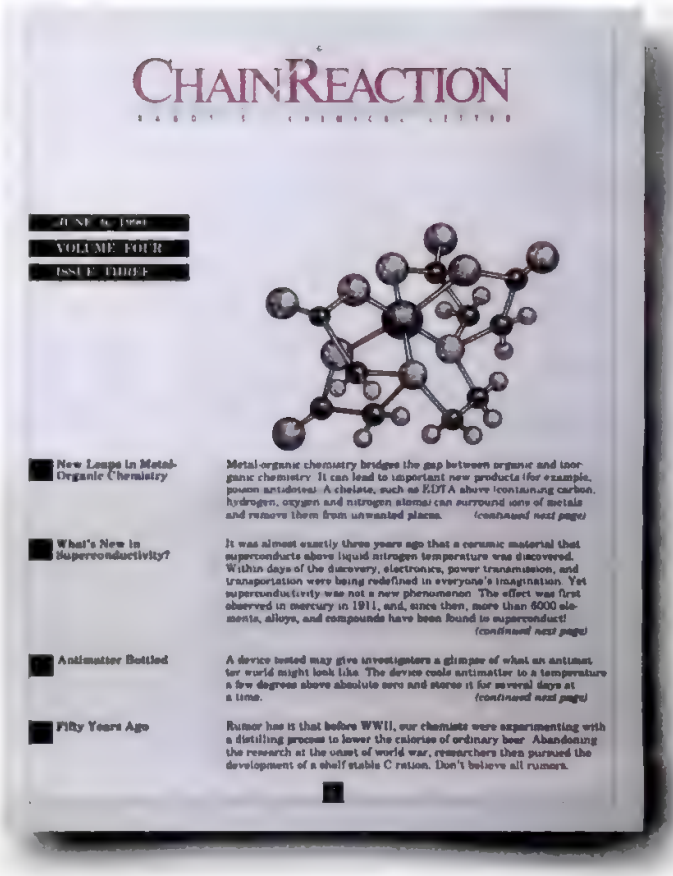
Scientists are still unable to confirm the existence of even a single black hole, despite widespread belief that such things should exist. Tracking down these invisible objects isn't easy, because they can only be studied indirectly by the effects they have on their surroundings. There are several types of places that

(continued on page 3)

MIRROR, MIRROR

It's a chore, but all reflecting telescopes require cleaning their reflective mirrors. Eventually, the aluminum coating on their mirrors deteriorates and needs replacing. For large instruments, the process requires removing the tele-

(continued on page 3)



CHAIN REACTION

EARTH'S CHEMICAL LETTER

JUNE 6, 1990

VOLUME FOUR

ISSUE THREE

New Leaps in Metal-Organic Chemistry

Metal-organic chemistry bridges the gap between organic and inorganic chemistry. It can lead to important new products (for example, poison antidotes). A chelate, such as EDTA above (containing carbon, hydrogen, oxygen and nitrogen atoms) can surround ions of metals and remove them from unwanted places. *(continued next page)*

What's New in Superconductivity?

It was almost exactly three years ago that a ceramic material that superconducts above liquid nitrogen temperature was discovered. Within days of the discovery, electronics, power transmission, and transportation were being redefined in everyone's imagination. Yet superconductivity was not a new phenomenon. The effect was first observed in mercury in 1911, and, since then, more than 6000 elements, alloys, and compounds have been found to superconduct! *(continued next page)*

Antimatter Bottled

A device tested may give investigators a glimpse of what an antimatter world might look like. The device cools antimatter to a temperature a few degrees above absolute zero and stores it for several days at a time. *(continued next page)*

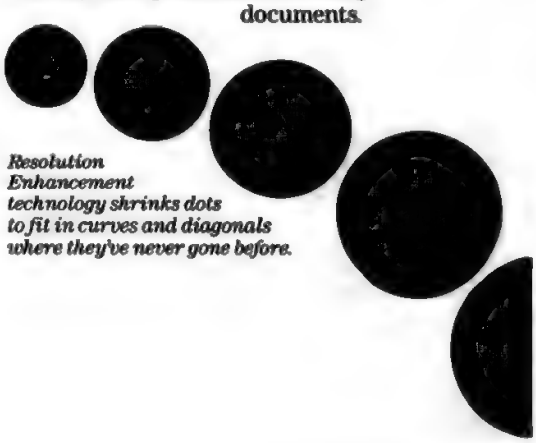
Fifty Years Ago

Rumor has it that before WWII, our chemists were experimenting with a distilling process to lower the calories of ordinary beer. Abandoning the research at the onset of world war, researchers then pursued the development of a shelf stable C ration. Don't believe all rumors.

Introducing the new HP LaserJet III printer with Resolution Enhancement technology.

The rules have changed. Now the name of the game is Resolution Enhancement technology. You'll call it the best thing to happen to laser printing since the very first HP LaserJet printer. It gives you clearer resolution. Curves that really curve. And edges that are never jagged.

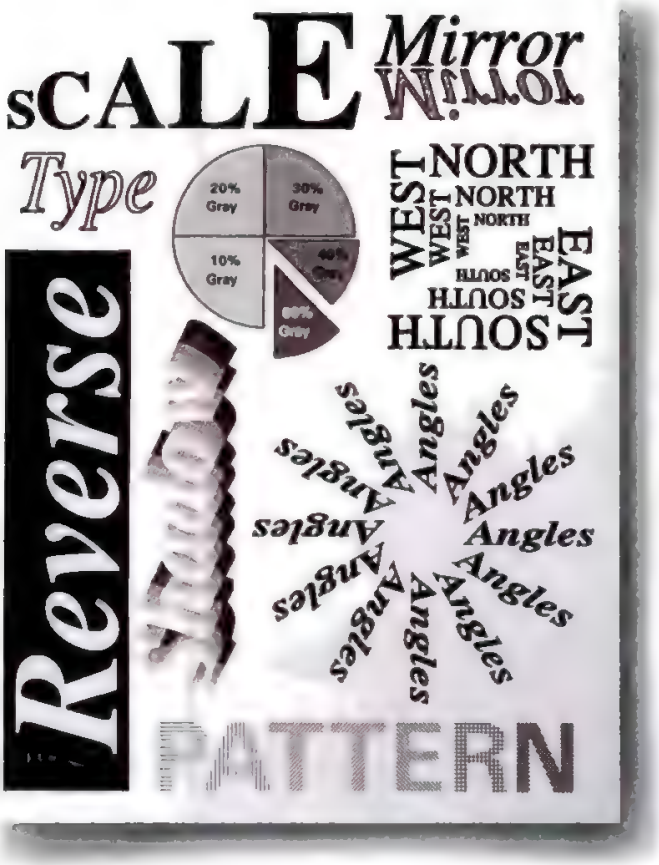
Instead of a "one-size-fits-all" dot, HP's built-in intelligence varies dot sizes. So they can fill areas where they could never go before. For clearer, more professional-looking documents.

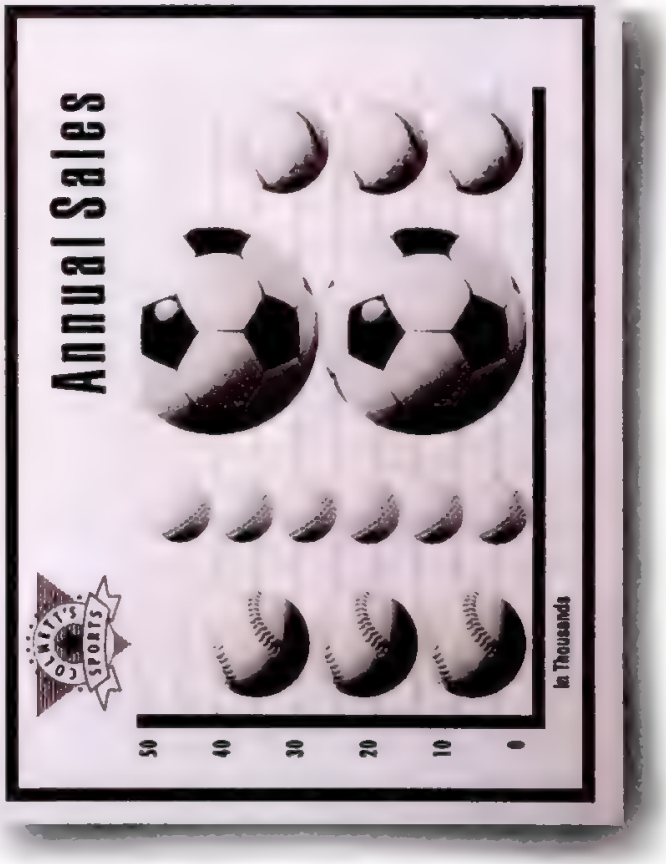


Resolution Enhancement technology shrinks dots to fit in curves and diagonals where they've never gone before.

©1990 Hewlett-Packard Company PE12003

whole new ball game.





But there's more than better print quality. 14 bit-mapped fonts and 8 internal scalable typefaces provide thousands of options. And enhancements to our PCL5 printer language, including our HP-GL/2 graphics language, let you print portrait and landscape on the same page. Reverse and angled type. Spirals. Even shaded text. You can also plug in Adobe PostScript® software.

For all its new features, the $2,395* list price of the HP LaserJet III is a good deal less than the HP LaserJet

Series II printer it replaces. With the same hardware compatibility, wide range of applications, 8 ppm print speed, and software compatibility, including WordPerfect 5.1 and WordStar® 6.0. And the same reliability as the rest of the HP printer family.

So call **1-800-752-0900, Ext. 1007.** Ask for our booklet on Resolution Enhancement technology and where to find your nearest authorized HP dealer. We'll put you in a whole new league.

There is a better way.

HEWLETT PACKARD

*Suggested U.S. list price. WordStar is a U.S. registered trademark of WordStar International Incorporated. Adobe and PostScript are registered trademarks of Adobe Systems, Inc.

CIRCLE 491 ON READER SERVICE CARD

LIGHT PENS: The Specialized Alternative

by Robert Kendall

Light pens, while they may not be as versatile as mice, come closest in function and design to that most intuitive of all pointing devices: the human finger.

The light pen is a natural for specialized menu-oriented database software. Hospital record keeping, point-of-sale operations, and automotive maintenance are the biggest markets. The light pen's main drawback is that constantly holding it up can quickly tire your arm.

SEEING THE LIGHT

A light pen works by means of a light sensor in its tip. An electron beam in the monitor scans the display 60 times every second and makes the phosphors glow. By sensing the time between these pulses, the pen determines its position on-screen. Pressing the pen tip against the screen functions like clicking a mouse button.

Just as mice function differently in various environments, so do light pens. Thus, we evaluated light pen types from several different manufacturers: FTG Data Systems, of Stanton, California ((800) 962-3900; (714) 995-3900); HEI Inc., of Victoria, Minnesota ((612) 443-2500); The Lite-Pen Company (L-PC), of Los Angeles, California ((800) 634-1967; (213) 305-7616); and Warp Speed Light Pens Inc., of Alto, New Mexico ((800) 874-4315; (505) 258-5713).

DIFFERENT STROKES

Color monitors require different pen sensitivities than monitors that use long-persistence phosphors, such as the original IBM monochrome display. For color screens, you can choose HEI's $142.88 Model 30 or its more accurate $160 Model 75 Pixel Light Pen; FTG's $199 FT-156 or the more accurate $249 FT-1000; or L-PC's $190 CPV. For long-persistence monochrome there's HEI's $145.88 Model 32, FTG's $220 FT-176X, and L-PC's $210 MPV. Warp Speed offers its $199.99 Personal Computer Light Pen in color or long-persistence versions.

HEI and L-PC make pens that automatically adjust their sensitivity to either color or long-persistence monitors: HEI's Model 72 AGC Light Pen is $171.25, while L-PC's HPV and its more accurate Pro-Pen are each $210. L-PC also markets the $210 CST (with a button on the side instead of a push tip) and the $180 VPT and $160 CPT (both with detachable chords).

PIXEL-LEVEL RESOLUTION

Light pens can plug directly into the light pen port found on most EGA boards, but this allows cursor movement for only a block of pixels at a time instead of single pixel increments. To achieve the pixel-level resolution necessary for graphics, all the vendors except HEI offer add-on interface boards, which also support VGA cards. FTG offers the $189 PXL-380 board for EGA or VGA and the $179 PXL-480 for the PS/2. L-PC markets the $160 Pixel Plus 1 card for use inside ATs and XTs with EGA or VGA displays and the $175 Pixel Plus 2 for the PS/2 Model 30 and Compaq II. Warp Speed offers the VGA-only $149.99 Phaser Two card for the PC and PS/2; the card won't work with some clones.

According to HEI, its Pixel Light Pen can achieve pixel-level resolution via the light pen port—if you write your own driver. The vendor provided us with nothing that could demonstrate this capability, however.

BUSINESS APPLICATIONS SUPPORT

Because few business applications provide light pen support, vendors must supply their own application drivers. FTG is the clear winner here; it's the only vendor to provide us with a *Microsoft Windows* driver. FTG's mouse emulation software was uniquely easy to install. FTG also provided the easiest calibration routine for initially aligning the cursor beneath the pen tip, as well as the best documentation.

We tested FTG's FT-1000 with the PXL-380 board in *PageMaker*, *Windows Paint*, and *Windows Write*. Double-clicking took a little getting used to, but the pen proved very accurate for menu selections and manipulating document elements.

Warp Speed is the only other vendor committed to supporting business applications, providing drivers for *GEM*, *Ventura*, *Lotus 1-2-3*, *Symphony*, *WordStar*, *dBASE III Plus*, and *MultiMate Advantage*. You also get a simple hard disk manager. A mouse emulation program is available for $49.99.

Light pens from FTG Data Systems, HEI Inc., The Lite-Pen Company, and Warp Speed Light Pens Inc. (top to bottom) complement menu-oriented database applications.

PHOTOGRAPHS THOM O'CONNOR

We tested Warp Speed's Personal Computer Light Pen with the Phaser Two board on a PS/2, since the vendor claims the MCA bus allows more-accurate performance than the AT bus. The *Lotus 1-2-3* driver and the hard disk manager were functional but unremarkable. Some selections required a second press. At review time, the mouse emulation program did not support the PS/2.

HEI and L-PC currently provide no software support for business applications. However, L-PC is planning to release a Universal Light Pen Adapter, an interface that plugs into the serial port and lets the light pen emulate a mouse via the hardware.

We tested HEI's light pens and L-PC's Pro-Pen with the crude sample BASICA programs the vendor provided. The lack of pixel-level resolution was a major hindrance in HEI's paint program; menu selections frequently required several presses. With the L-PC pen, positioning the cursor was accurate within the programs' text-mode limits, but it was hard to make menu selections.

FTG has best succeeded in making the light pen a viable input device for business use, though it is more expensive than the mouse. Warp Speed also has something to offer the business user, though the lack of both a *Windows* driver and pixel-level resolution on EGA systems is a serious drawback. ■

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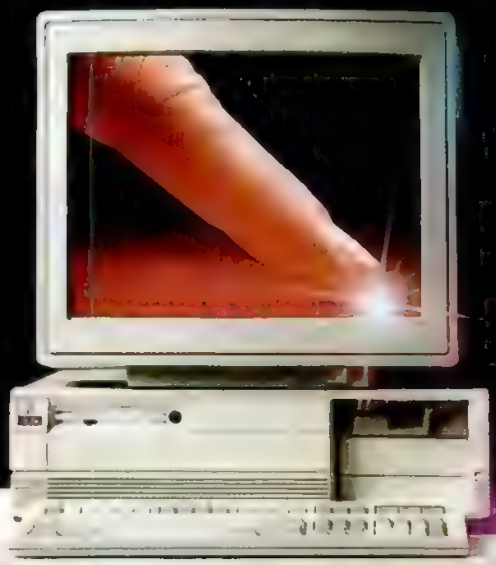

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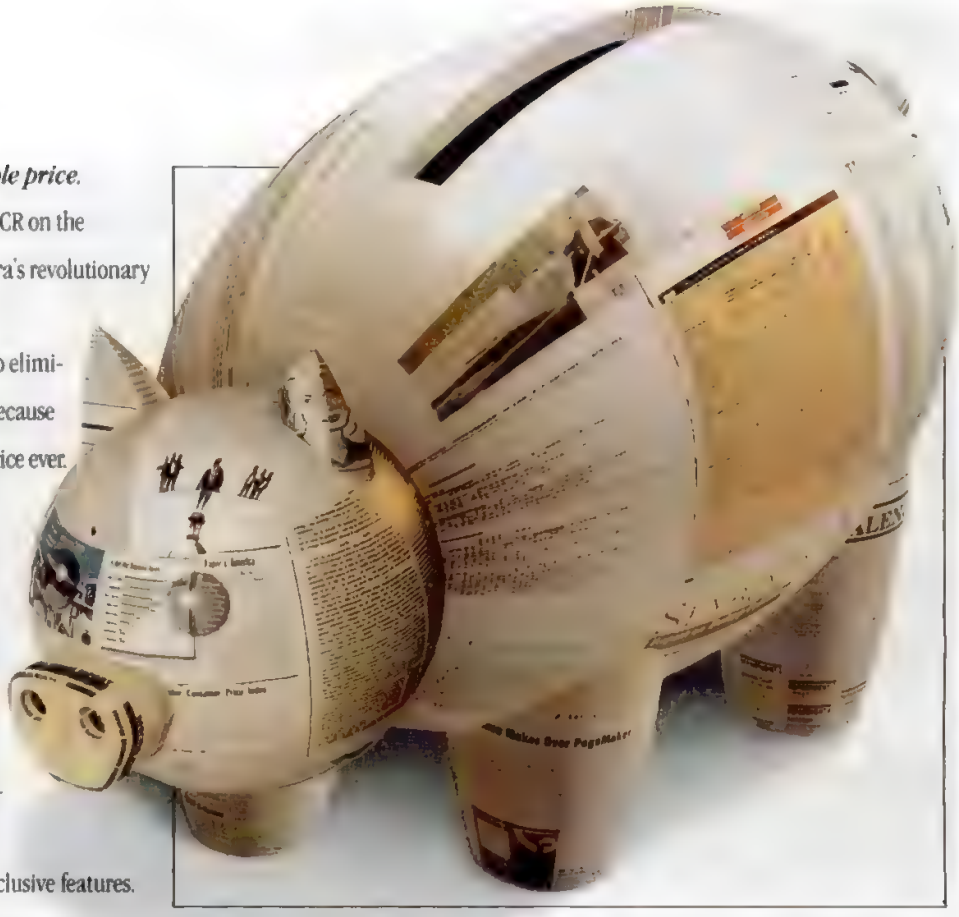

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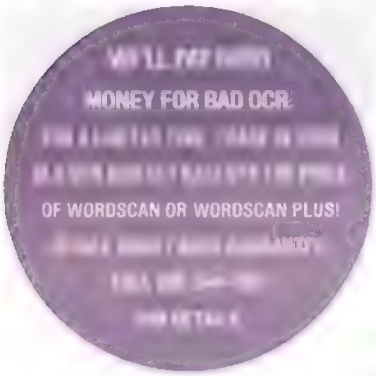

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ternate input device is actually a trackball. At review time, only the $169.95 PS/2 version was available, but serial and AT-bus versions are due out by the time you read this.

The Expert Mouse is distinguished by its large 2-inch ball, of which an entire hemisphere is exposed. This enables a single finger motion to move the cursor further than with smaller balls. This feature, along with the product's dynamic tracking, compensates somewhat for its relatively low 200-ppi resolution.

The Expert Mouse's two buttons are irregularly shaped to follow the curve of the ball. Chording can function as a click lock so you don't have to hold down a button while rolling the ball to click and drag. A pop-up control panel lets you reassign the click lock or adjust ballistic tracking within an application. You can even customize the ballistic acceleration curve by editing a parameter file.

The Kensington Expert Mouse's well-designed features include easy installation and clear documentation.

A bank of DIP switches on the trackball lets you make button reassignments that stay in effect within programs—such as *Windows*—that won't recognize the Kensington driver. In our *Windows* compatibility test, the mouse successfully emulated both the Microsoft Mouse and IBM PS/2 Mouse.

Topping off the Expert Mouse's other well-designed features are easy installation, clear documentation, and TSR mouse menus for DOS and 21 other applications, including *WordPerfect*, Versions 4.2 and 5.0; *Lotus 1-2-3; Symphony; dBASE III;* and *Paradox*. The bottom line? If you don't mind paying Kensington's premium price, you'll be getting a high-quality product.

Kensington Expert Mouse
Kensington Microware Ltd., 251 Park Ave. South, New York, NY 10010; (800) 535-4242, (212) 475-5200.
List Price: $169.95.
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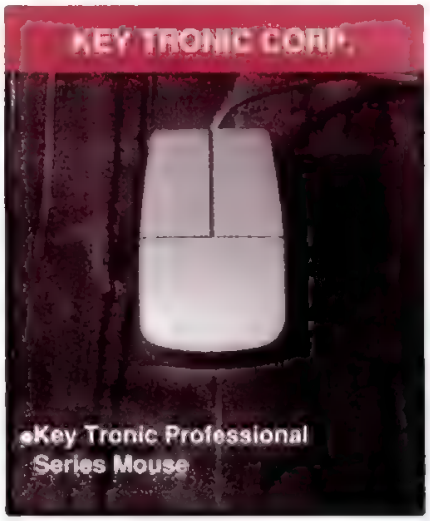
ALTERNATE INPUT
MICE AND TRACKBALLS



•Key Tronic Professional Series Mouse

by Robert Kendall

Key Tronic is best known for its extensive line of replacement keyboards. Apart from a keyboard with a built-in touch pad, the Professional Series Mouse is the company's only venture into alternate input territory.

Both the serial and bus models of the Professional Series Mouse are available for $109. Both versions are identical in appearance and performance, except that the bus board allows IRQ selection. These mice depart from the rest of the pack in look and feel only in the small raised bumps on the left button.

The mouse comes with predefined menus for *Lotus 1-2-3*, *WordPerfect* 4.2 and 5.0, and *dBASE III Plus*. An extra $27 buys you a Programmer's Tool Kit for constructing your own mouse menus. Surprisingly, the company offers no bundling options.

Though it garnered an Editor's Choice in *PC Magazine*'s last look at mice (February 14, 1989, "Alternate Input Devices: Tracking the Mouse's Progress"), the Professional Series Mouse now seems unremarkable. In a market rapidly filling with high-resolution devices equipped with ballistic tracking, Key Tronic offers only 200-ppi resolution and dual-rate tracking that lets you double the tracking rate at a user-specified speed threshold. It uses mechanical rather than the more durable optomechanical sensors that are now the industry norm. Even its once low price is now strictly run-of-the-mill.

Nevertheless, elements that made it a winner last time around remain the same: the mouse is easy to install, clearly documented, and presented no unpleasant surprises. The driver lets you set horizontal and vertical sensitivity either with command line switches or on the fly from a pop-up screen within an application.

If you're looking for a proven, mid-range product, this one is a reliable choice.

Key Tronic Professional Series Mouse
Key Tronic Corp., PO Box 14687, Spokane, WA 99214; (800) 262-6006, (509) 927-5515 (in Washington).
List Price: Serial and bus model, $109.
CIRCLE 624 ON READER SERVICE CARD

•Kraft Trackball

by Tom Unger

Kraft Systems Inc.'s $129.95 cure for cramp-fingered trackball users proves there is something new under the sun after all: a foot pedal. That's right, in addition to its single locking and three momentary buttons, this serial, optomechanical device gives you the opportunity to put your money where your foot is.

Connected to the back of the trackball by an ordinary telephone cable and RJ11 jack, the rugged 1.5-by-2-by-4-inch (HWD) foot pedal makes all the difference. Because pressing the foot pedal functions like the left mouse button, I found that I was able to substitute foot pressure for finger-presses almost entirely.

In all other respects, the Kraft Trackball performs like any other high-end trackball. Setup is blissfully simple and automated. An installation program copies the .COM or .SYS drivers to your boot disk and, if you wish, adds a command line to your AUTOEXEC.BAT or CONFIG.SYS files. Kraft's trackball emulates the Microsoft Mouse, and includes a combination test and demonstration program that lets you know whether or not your trackball is properly installed.

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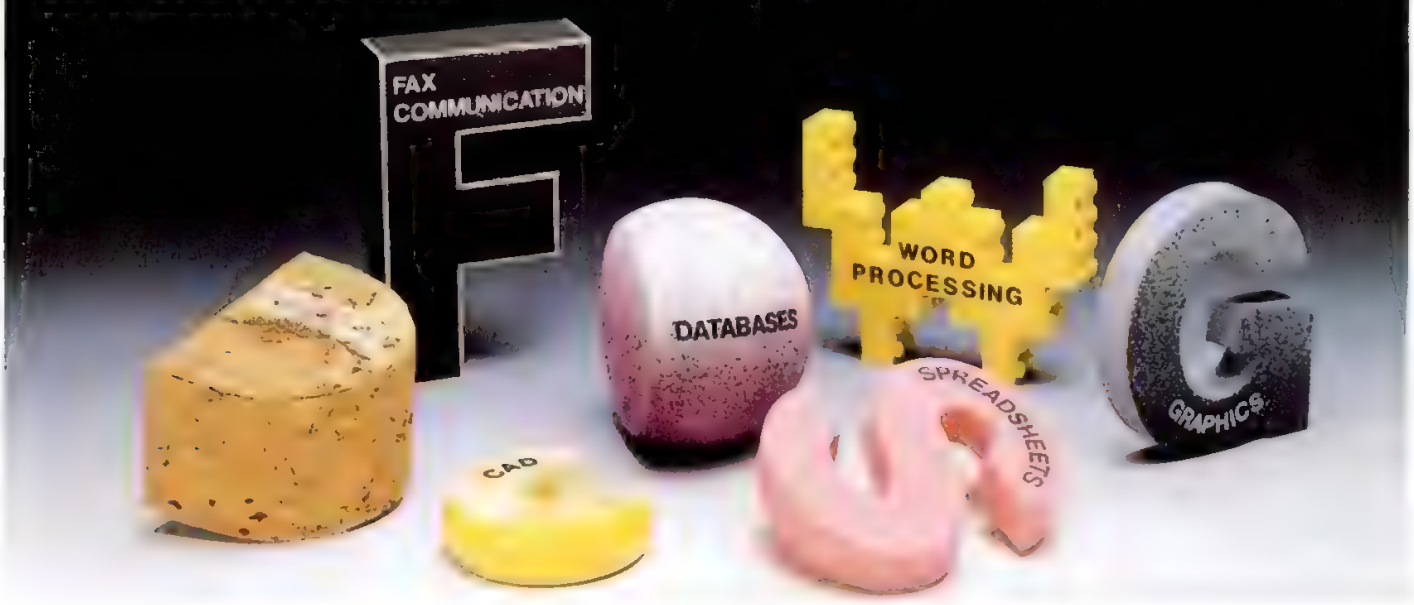

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CIRCLE 742 ON READER SERVICE CARD

they do on the Microsoft Mouse. The center button has the same effect as pressing right and left buttons simultaneously. The locking drag button is located above and to the left of the ball, within easy reach of your index finger.

The Key Tronic Professional Series Mouse, once an Editor's Choice, now seems unremarkable, offering only 200-ppi resolution.

Kraft's *Speed Panel* utility, which can be loaded as a TSR, enables you to change the trackball's base 200-ppi resolution from 10 to 1,150 ppi. The Kraft Trackball does not yet support true ballistic tracking, but Kraft intimated that ballistic tracking is in the works.

Although Kraft does not include emulations other than the Microsoft Mouse, the company does include an on-disk "Fast-Start" manual which provides details on how to configure many CAD, paint, spreadsheet, and word processing programs for use with the trackball.

Although not included with our review unit, Kraft says it is now shipping its trackball with Version 3.0 of the driver which, it claims, is much improved.

The documentation is well organized and leaves little to the beginner's imagination. A $17 programmer's manual can be ordered along with EGA and VGA paint programs from a coupon included in the manual. The trackball and foot pedal carry a five-year warranty.

Kraft, which also sells a $79 serial mouse (not reviewed), offers its trackball *sans* foot pedal for $10 less. But when you've got a reasonably priced trackball that promises to give you all the comfort of a regular mouse without requiring a lot of desk real estate, why settle for less? Check out the Kraft Trackball—it may just be the best of both worlds.

Kraft Trackball
Kraft Systems Inc. 450 W. California Ave. Vista, CA 92803; (619) 724-7146.
List Price: With footpedal, $129.95; without, $119.95; footpedal only, $19.95; programmers' manual, $17; *Telepaint-CGA*, $49.95; *Splash!-VGA*, $59.95.

CIRCLE 625 ON READER SERVICE CARD

KYE INTERNATIONAL CORP.

by Kellyn S. Betts

The appeal of KYE International's trio of three-button mice is strictly in price and packaging. With suggested retail prices

Here's the world's

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ranging from $49 to $109, these mice come bundled with a wealth of hardware and software accessories.

Its price makes the GM-6X KYE's best-selling model. In fact, a spokesperson claims the company's dealers can profitably sell the product at three-fifths of its $49 suggested retail price. But regardless of its cost, the GM-6X is not a mouse most serious PC users would consider. The last time we reviewed mice (February 14, 1989, "Alternate Input Devices: Tracking the Mouse's Progress"), *PC Magazine* called both the GM-6X and its slightly higher-end cousin, the $79 GM-6000, "enhanced designs of a mouse that has seen better days." And in the year-and-a-half that has elapsed since then, only these mice's bundling options have changed; both still sport four-year-old boxy designs.

KYE's other mouse, the brand new GM-F303, is far more modern. Housed in a slightly longer, flatter, and less rounded case than the Microsoft Mouse, the GM-F303 has one additional button but is similar in general shape, color, and composition. Closer inspection shows some important differences: the F303's smaller and lighter ball is positioned further from its button end, giving it a different center of gravity. Combined with its boxier shape, the result is a less sturdy feel.

The Genius Mouse GM-F303 offers some advantages over the Microsoft Mouse. It's compatible with a wider range of software, emulates Mouse Systems mice, and is less expensive.

The GM-F303 does offer some advantages over the Microsoft Mouse. It's compatible with a wider range of software; it emulates Mouse Systems mice as well as Microsoft mice. It is also less expensive. Bundled with a mouse pocket and pad, 9-pin serial, 9-to-25-pin serial, and PS/2 adapters, as well as *MenuMaker* (by Pecan Software Systems), *CasCAD I*, and the *Dr. Genius* paint program, the mouse costs $109. It is also available without the *CasCAD* software and PS/2 adapter in a $99 bundle confusingly called the GM-F302. In both cases the mouse supports ballistic tracking and has a base resolution of 350 ppi. The resolution is software- and hardware-adjustable, giving it a range of 43.75 to 2,800 ppi. The mouse comes with .COM and .SYS drivers, adequate documentation, and is easy to install.

KYE's low prices and generous bundling options make them seem a good deal. But unless you're fond of mouse shapes that don't conform to the curves of your hand, the only one worth considering is the GM-F303.

Genius Mouse GM-6X
Genius Mouse GM-6000
Genius Mouse GM-F303
KYE International Corp., 12675 Colony St., Chino, CA 91710; (800) 456-7593, (714) 590-3940.
List Price: GM-6X, $49; GM-6000, $79; GM-F302, $99; GM-F303, $109.
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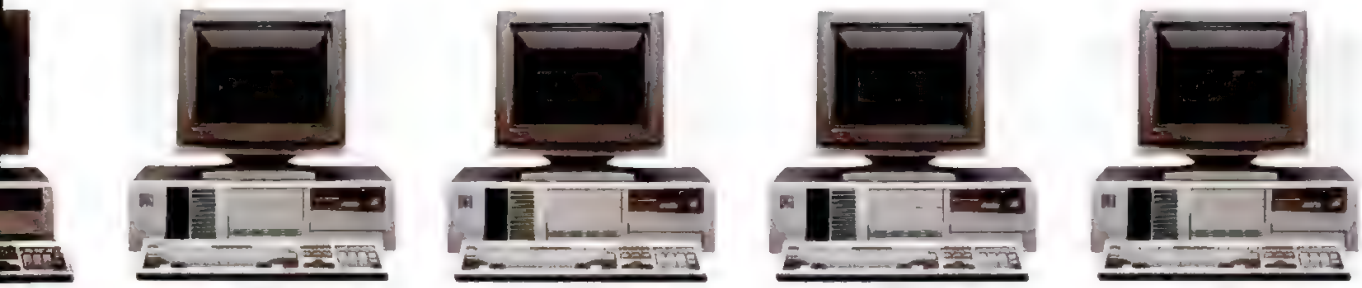

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LIUSKI INTERNATIONAL

•ProCorp Mouse

by Bill O'Brien

ProCorp mice are distributed in serial and bus versions exclusively by Liuski International, a third-party vendor of alternate input devices. The ProCorp looks much like the early Microsoft mice, and its design is still very close to the CMS Mini and the SmarTEAM Mouse (both reviewed in this article). Either version of the ProCorp will remove $89 dollars from your wallet, but there are more-subtle factors on which to base your decision.

The serial mouse won't tie up an extra interrupt or I/O slot, but its resolution is a mere 250 ppi versus the bus mouse's 340 ppi. According to Liuski International, a 400 ppi version of the serial device is planned, but unreleased at this time.

Identical drivers power both devices and give surprising flexibility in setting the tracking speed both in horizontal and vertical planes. Neither mouse supports ballistic tracking.

Installation posed no problem, and the mice worked flawlessly under DOS and *Microsoft Windows*. The 70-inch connecting cable made routing either of these mechanical mice over or through the clutter on my computer a snap. The installation documentation is sparse and gives no information regarding the function of the third mouse button. Primary documentation covering current additions or changes is contained in a README file.

Dr. Halo III (from Media Cybernetics Inc.) is bundled with the package, and the ProCorp mice support *AutoCad*, *Word*, *Windows*, *GEM*, *Flight Simulator*, and most other mouse-compatible programs.

If you need mouse capabilities in a plain vanilla package at a reasonable price, consider the ProCorp Mouse.

ProCorp Mouse
Liuski International, 10 Hub Dr., Melville, NY 11747; (516) 454-8220.
List Price: Serial or bus model, $89.

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Identical drivers power both the serial and bus versions of the Liuski ProCorp Mouse and give surprising flexibility in setting tracking speed both in horizontal and vertical planes.

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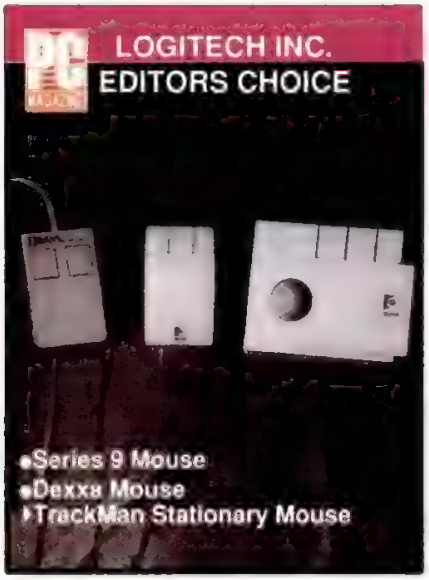

by Tony Rizzo

Looking for an alternative to the "Dove bar"? Logitech has long been an advocate of three-button mouse technology, and its one-third share in the mouse market is testimony to the PC public's healthy interest in this variety of rodent. Currently in its fourth generation of design, Logitech's mice are more square than Microsoft's, and they slope down at the front, providing a comfortable platform for your fingers.

Logitech is nothing if not diverse; the company offers a full line of high-, middle-, and low-end three- and two-button mice, as well as a trackball. At the high end of the ladder, Logitech's three-button Series 9 Mouse is available in three standard configurations: a serial version at $119, a bus version at $139, and a PS/2 version at $119. Logitech also offers a serial-PS/2 version for $149—but think twice before you lay out $40 more to attach your PS/2 mouse to the PS/2 serial port. PS/2s include their own mouse ports.

Logitech also makes an excellent trackball, the TrackMan, which sells for $139 for the serial version and $149 for the bus version. The TrackMan shares the same driver software as the Series 9 Mouse and is designed for right-handed people. The roller ball is offset to the left, and the buttons are forward and to the right. This design is intended to accommodate those users who prefer a fully open hand. The Series 9 mice and the TrackMan come with proprietary software—the *LogiMenu* menuing program and *Mouse-2-3*.

At the low end, Logitech offers its two-button Dexxa Mouse at $79 if purchased with *Paintshow Plus* (Logitech's newest paint program), or $69 without software. It is available in either a serial or bus configuration. Note that Logitech manufactures this mouse for the Dell Corporation as well, and while Dell's $59.95 price is initially lower, you may find the Dexxa Mouse at a significant discount.

The serial TrackMan and the serial Series 9 Mouse are not compatible with the *Microsoft Windows* Microsoft Mouse driver, but *Windows* itself provides a driver for them. Both the Dexxa Mouse and the bus version of the Series 9 Mouse are compatible with the *Windows* Microsoft Mouse driver.

Logitech has proven itself an apt competitor in the alternate input arena. If the "Dove-bar" shape doesn't wash for you, check out Logitech's designs.

Series 9 Mouse
Dexxa Mouse
▸ TrackMan Stationary Mouse
Logitech Inc., 6505 Kaiser Dr., Fremont, CA 94555; (415) 795-8500.
List Price: Series 9 Serial Mouse, $119;

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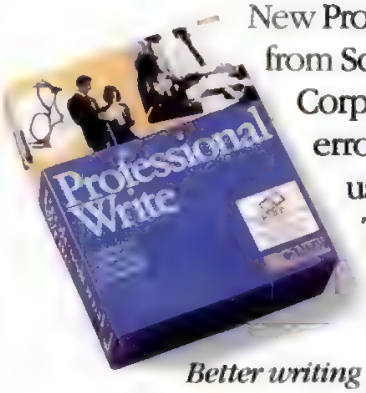

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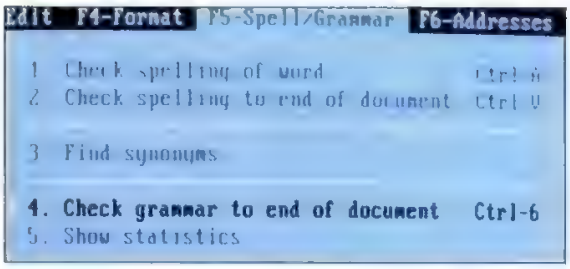

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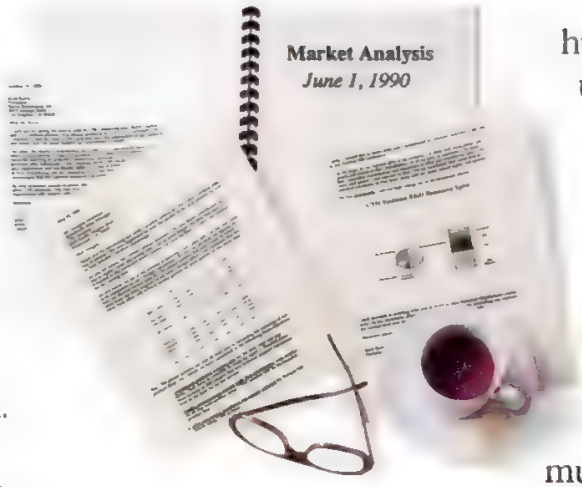

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Series 9 Bus Mouse, $139; Series 9 PS/2 Mouse, $149; Series 9 Serial-PS/2 Mouse, $149; Dexxa Mouse (serial), $79 (with *Paintshow Plus*); Dexxa Mouse (serial), $69 (without software); TrackMan Stationary Mouse (serial), $139; TrackMan Stationary Mouse (bus), $149.

CIRCLE 628 ON READER SERVICE CARD

•Lynx Turbo Trackball

by Alan Cohen

The Lynx Turbo Trackball from Lynx Computer Products Inc. is a lot like the cult movie that plays to half-empty houses every Friday at midnight. It's a good, solid piece of work that only a handful of people will appreciate.

There's valid reason for this. At $129.95, Lynx is not the cheapest trackball around, and its dearth of emulations and jazzy features may not appeal to the gizmo-crazy PC user.

Nonetheless, Lynx gets the job done. It features 250-ppi resolution, Microsoft Mouse compatibility, tracking speed adjustable via the DOS command line, and simple installation. An easy-to-follow user's guide is understandable even by neophytes. Menuing software and drivers for DOS, *WordPerfect*, and *Lotus 1-2-3* are also included.

With two buttons resting below a center ball, users can easily perform their point-and-clicks. The trackball features ballistic tracking, and worked well with *Microsoft Windows*. But it felt a bit clumsy with *PageMaker*, where dragging action and finer cursor control are needed. Because Lynx's ball is just under 1.5 inches in diameter, users with large hands may find the unit slightly awkward.

If your desk space is limited, and you don't care much about fancy features, check Lynx out. It's a solid, plain vanilla trackball. Mechanically identical serial, bus, and PS/2 versions are available separately.

Lynx Turbo Trackball
Lynx Computer Products Inc., 120 Linden Ave., Long Beach, CA 90802; (800) 321-LYNX (in U.S. and Canada), (213) 590-9990.
List Price: Serial, bus, and PS/2 models, $129.95.

CIRCLE 629 ON READER SERVICE CARD

•Marconi Mercus RB2-305

by Fredric Burke

Marconi Circuit Technology Corp. is not a household name in this country. The company is better known throughout the industry as an OEM supplier for organizations like Apple, IBM, and the government. Marconi's only two products for U.S. distribution—the RB2-305 and the RB2-306 trackballs ($152 each)—are as solidly built and easy to use as any alternate input device.

The RB2-305 and the RB2-306 are physically similar; software is where the two diverge. The serial version, the RB2-306, comes bundled with *Popup Menus* and *Ultrares*, a ballistic tracking editor, while the bus version does not. Both models, however, will support *AutoCAD*, *FutureNET*, and *OrCAD*.

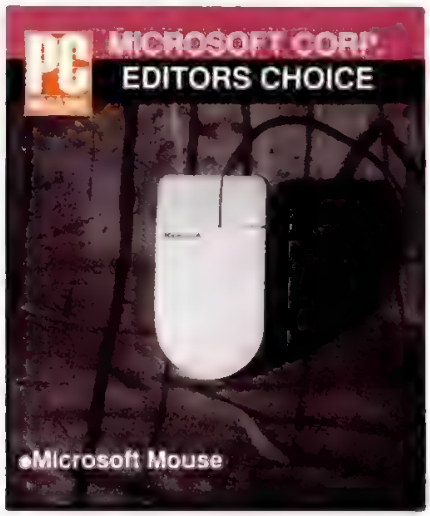
The 306 also comes with a Microsoft Mouse emulator. All Microsoft emulations (such as *Windows* and *Paintbrush*) for the 306 went off without a hitch. The rest of the software is similarly refined and proved trouble free in a variety of applications. Combine this with easy installation, a smooth tracking action and decent if muffled button feedback, and the RB2 trackballs can be used with confidence.

On the downside, neither trackball is PS/2 compatible, though Marconi is hard at work on the necessary software and plans to release it soon. Also, at $150 for only the trackball with the necessary driver software, a Microsoft Mouse and *Paintbrush* bundle can start to look awfully good.

Why a trackball? Granted, they're chunky oddballs in these days of svelte mice and slimline computers. But if desktop space is at a premium, and alternate input with small space requirements appeals, then the RB2s are just the ticket.

RB2-305
RB2-306
Marconi Circuit Technology Corp., 160 Smith St. Bldg 100, Farmingdale, NY 11735; (516) 293-8636.
List Price: RB2-305 and RB2-306, $152 each.

CIRCLE 630 ON READER SERVICE CARD



•Microsoft Mouse

by Tony Rizzo

The undisputed King of Mice, Microsoft manufactures and sells nearly half the mice bought every year, and for good reason. Its mouse is so good that the entire industry supports, emulates, and copies it. In 1988, making a good product even better, Microsoft introduced the ergonomically correct "Dove bar" design, which has already become a classic and earned it a *PC Magazine* Technical Excellence Award that year and an Editor's Choice a year later. This is the mouse against which all others are measured.

What's new for Microsoft? Higher resolution—400 dpi—and some new packaging strategies. For the first time ever, Microsoft sells its mouse à la carte for $125, which means you should be able to buy it for less than $100 on the street.

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Bundled with *PC Paintbrush* (by Z-Soft Corp.), it costs $150. With a full version of *Microsoft Windows* 3.0, you'll see a list price of $225. (Microsoft no longer sells it with a runtime version of *Windows 286*.) The mouse is available in serial, PS/2, InPort, and bus versions.

The mouse comes with two versions of Microsoft's mouse driver, Version 7.0: MOUSE.SYS for installation through CONFIG.SYS, and MOUSE.COM for installation from the command line. There is also support for OS/2.

CPANEL.EXE provides configuration support for both linear and ballistic tracking, covering the range from very fast to very slow. (Ballistic control can be turned off.) CPANEL is invoked from the command line by simply pressing Ctrl-Shift and the left mouse button. Rounding out the software is a copy of *Microsoft Paintbrush* or *Microsoft Windows*, and a little game called BOA, which sends a snake after the mouse pointer.

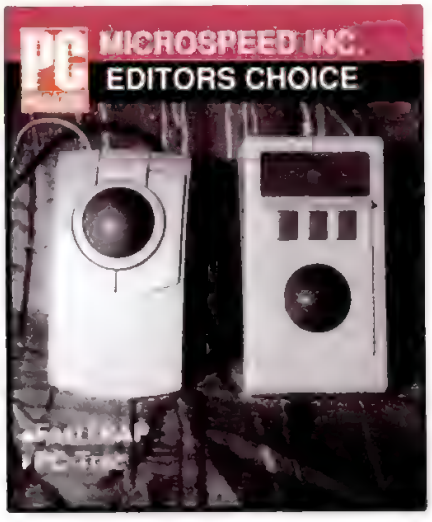
The undisputed King of Mice, Microsoft manufactures and sells nearly half the mice bought every year, and for good reason.

The ball is slightly forward from the mouse's center, and provides good traction on the desk. With ballistic control turned on, it is possible to cover the entire screen by using about 1 square inch of disk space. Ballistic control takes a good bit of getting used to, and with both linear and ballistic settings set very high, the cursor is almost impossible to control.

For absolute compatability, comfortable design, and top-notch quality, you'll find the Miscrosoft Mouse, no matter what package you purchase it in, is worth every penny.

Microsoft Mouse
Microsoft Corp., 1 Microsoft Way, Redmond, WA 98052; (206) 882-8080.
List Price: $125, with *Microsoft Paintbrush*, $150; with *Microsoft Windows* 3.0, $225.
CIRCLE 631 ON READER SERVICE CARD

ALTERNATE INPUT
MICE AND TRACKBALLS



by Mary Kathleen Flynn

While trackball technology may not seem exciting to you, the folks at MicroSpeed would rather build a better trackball than figure out who killed Twin Peaks' Laura Palmer. As a result of this diligence, MicroSpeed unveiled a truly improved trackball design this January. The new PC-Trac and Logitech's TrackMan are the best designed trackballs in this roundup. The only bad news is that MicroSpeed's FastTRAP trackball, which provides support for 3-D applications, is still stuck with the old design.

To create the PC-Trac's new look and feel, MicroSpeed turned to some of the original Microsoft Mouse designers from ID Two in San Francisco. Like the "Dove bar," the new case slopes down, letting your wrist relax rather than forcing it to tilt up as with most other trackballs. And in the new design, two large crescent-moon buttons surround the ball, allowing hands of all shapes and sizes to feel comfortable using the device. A third button, placed in the center above the ball, lets you lock on the cursor while you drag a selection. The PC-Trac comes in serial, PS/2, and InPort versions for $119 and in a bus model for $139.

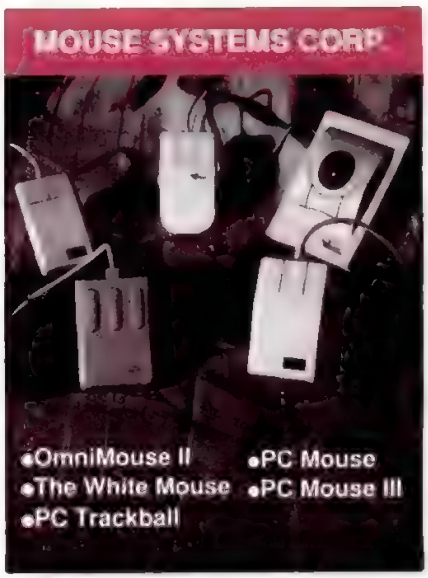
Unfortunately, MicroSpeed's FastTRAP is trapped in the older, clunkier design. Introduced in 1987, the FastTRAP is identical to the old PC-Trac except that it adds a wheel for the Z-axis—important in high-end 3-D CAD applications. The serial FastTRAP is $149, and the bus version is $169.

Both products support ballistic gain, which means the faster you roll the ball, the faster the cursor will fly across your display. Both have Drag/Lock buttons. Each comes with a self test that doubles as a setup, letting you adjust the cursor rate and other features. Both come with emulations for Microsoft and Mouse Systems, and both support the Microsoft Mouse driver in *Microsoft Windows*.

Also included with each product are MicroSpeed drivers, a CONFIG.SYS file, and a .COM file. (Unfortunately, the latter can't be uninstalled from DOS.) The redesigned PC-Trac comes with newer driver software, which includes pop-up menus for *Lotus 1-2-3*, *WordPerfect*, and *dBASE*.

In the last year, the market has been flooded with trackballs. Almost everyone but Microsoft has jumped in. But, with its new design, MicroSpeed has an excellent chance of floating on top. Now all the company has to do is re-rig the FastTRAP.

▶ **PC-Trac**
FastTRAP
MicroSpeed Inc., 44000 Old Warm Springs Blvd., Fremont, CA 94538; (800) 232-7888.
List Price: PC-Trac bus model, $139; serial, InPort, PS/2 versions, $119; FastTRAP bus model, $169, serial model, $149.
CIRCLE 549 ON READER SERVICE CARD



by Tony Rizzo

Mouse Systems, the company that made the very first mouse for the PC in 1982, now sells more mice than you can shake a stick at. Recently purchased by Genuis Mouse maker KYE, Mouse Systems has captured a sizeable portion of the alternate input market with its three mouse lines: PC Mouse (its flagship optical line), the two-button optomechanical OmniMouse, and The White Mouse (a three-button mechan-

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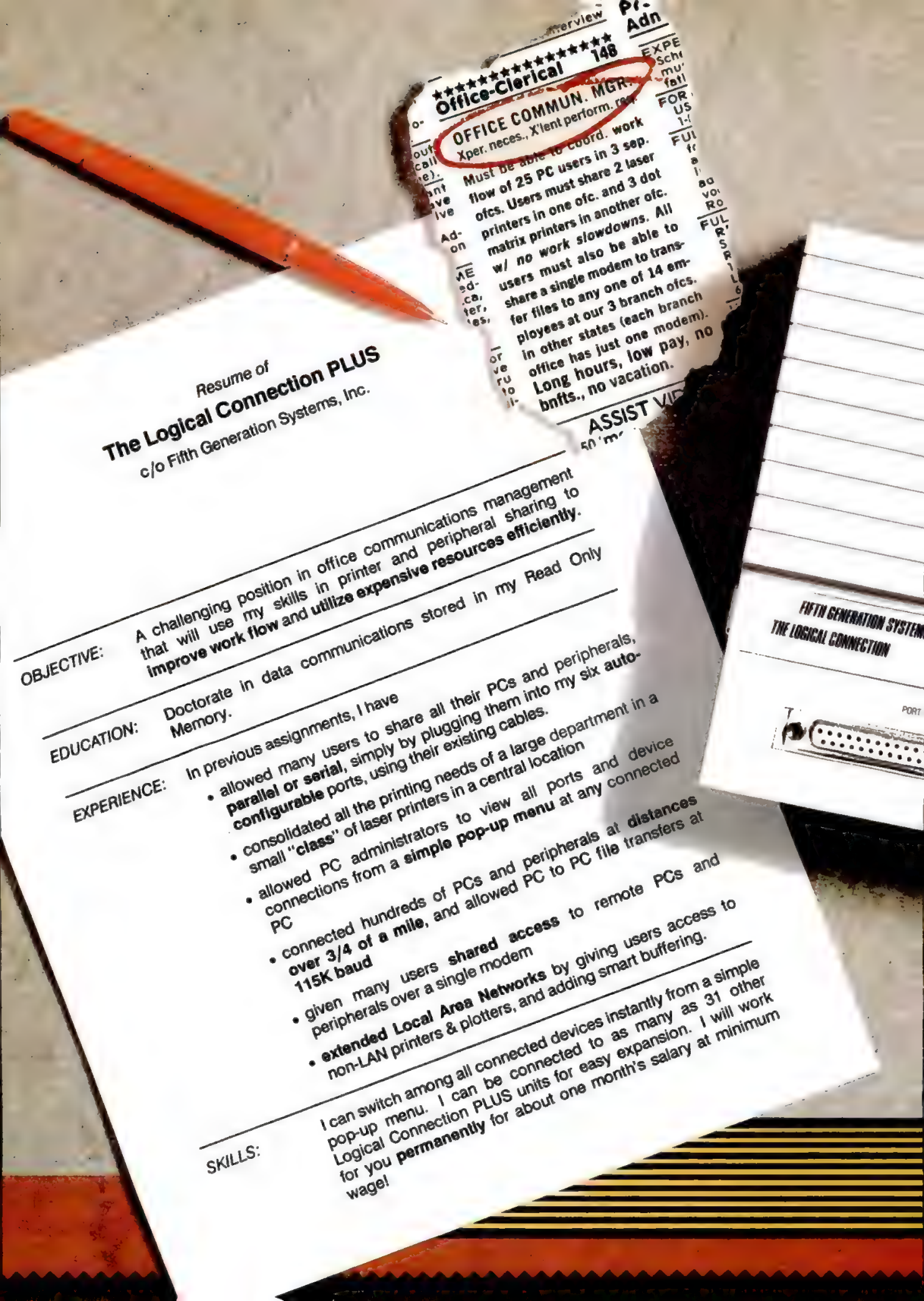
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Resume of
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EDUCATION: Doctorate in data communications stored in my Read Only Memory.
EXPERIENCE: In previous assignments, I have
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CIRCLE 298 ON READER SERVICE CARD

ical mouse line). And last fall, Mouse Systems introduced its PC Trackball.

As we went to press, Mouse Systems began shipping its PC Mouse III, calling it "the industry's most accurate mouse." This three-button mouse uses Mouse Systems' driver, Version 7.0, and the latest generation of optical technology. The serial version costs $149.95, and the bus version goes for $169.95.

According to Mouse Systems, the combination of a new mouse and driver makes the PC Mouse III 100 times more accurate than any other mouse on the market. Unfortunately, PC Mouse III arrived too late for PC Labs to validate these claims.

PC Mouse III is Mouse Systems' only three-button optical mouse that will run in two-button mode under *Microsoft Windows*. A simple slide switch on the back changes modes.

The high-end PC Mouse is a three-button optical mouse available in serial, bus, or PS/2 (all $149) versions. Mouse Systems has discontinued the PC Mouse II. *PC Paint Plus* and *Designer* pop-up menu software come with the PC Mouse.

Mouse Systems offers two entry-level mice, the three-button mechanical White Mouse—virtually the same as the Genius Mouse GM-F303 from KYE (reviewed here), and the two-button optomechanical OmniMouse II. The White Mouse is available in serial ($99.95) or bus ($119.95) versions, and includes *Power Panel*, a DOS shell. The optomechanical OmniMouse II is available for $79.95 in its serial version, and $99.95 as a bus mouse.

Maker of the first mouse, Mouse Systems claims its PC Mouse III is the industry's most accurate.

To round out the IBM PC product line Mouse Systems also offers a three-button trackball in either serial ($119.95) or bus ($139.95) versions. The Mouse Systems PC Trackball sports an interesting raised-dome design that integrates the three buttons into the dome just below the ball, making it a little easier to move the ball with two fingers while resting your thumb on the left button.

Mouse Systems also provides a variety of other minor mouse-related products, including mouse pads, bus and serial cards, as well as various software packages.

All of the mechanical mice and the trackball were compatible with the *Microsoft Windows* mouse driver, as was the new PC Mouse III. Overall, Mouse Systems, mice and trackballs are quality products, and Mouse Systems' updated driver ensures its competitiveness.

PC Mouse
PC Mouse III
The White Mouse
OmniMouse II
PC Trackball
Mouse Systems Corp., 47505 Seabridge Dr., Fremont, CA 94538; (408) 727-0351.
List Price: PC Mouse, $149; PC Mouse III (serial), $149; PC Mouse III (bus), $169; The White Mouse (serial), $119.95; OmniMouse II (serial), $79.95; OmniMouse II (bus), $99.95; PC Trackball (serial), $119.95; PC Trackball (bus), $139.95.
CIRCLE 550 ON READER SERVICE CARD

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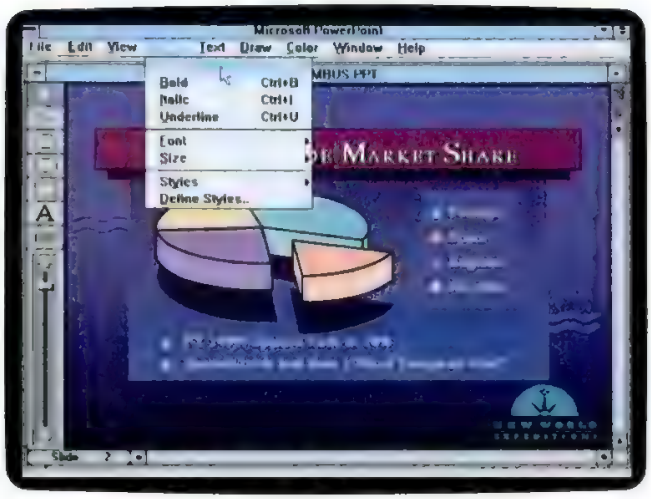

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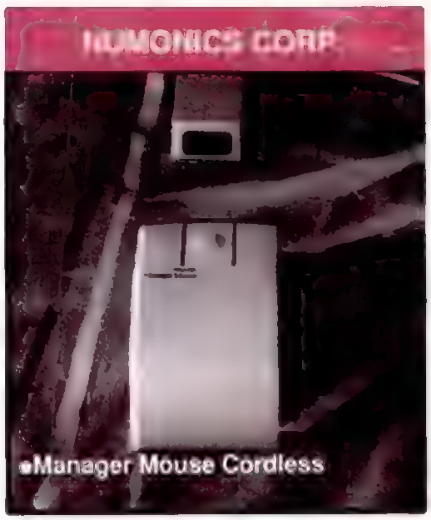

•Manager Mouse Cordless

by John R. Quain

Evolution is inevitable, and so if we lost our tails, the mouse was bound to follow. Numonics, known for its line of digitizing tablets, has built a rather slick, three-button, cordless mouse that brings the Darwinian theory to the desktop. At $175—about $25 more than Practical Solutions' Cordless Mouse, the only other cordless model in this roundup—such progress doesn't come cheap. But if you like the tabula rasa approach, Numonics' Manager Mouse does allow you to eliminate one more source of clutter.

Hardware compatible with the Mouse Systems' mouse, the Manager will work with the built-in Mouse Systems' drivers on most popular software, including *AutoCAD*, *Ventura*, *PC Paintbrush*, and *Microsoft Windows*. For those without a driver, Numonics supplies a Microsoft emulation to run on such programs as Software Publishing's *ClickArt Personal Pub* and Lotus' *Freelance*. The maunfacturer also supplies a TSR program called *Keyfree* for macros in nonmouse worlds. In PC Labs' tests, it functioned well without any unforeseen glitches or beeps.

Numonics conservatively claims that the 200-ppi Manager will communicate with its infrared receiver within a range of 45 degrees in all directions up to 4 feet away. When I attempted to confuse it by placing obstacles in its signal path, the mouse performed admirably, sniffing out the receiver within an area of about 90 degrees. So even though the technology is similar to that of a garden-variety TV or VCR remote control, you'll find it more successful at getting its instructions across. If, however, you like piling books on your desk, you should reconsider the tail.

Moreover, "cordless" isn't exactly accurate. You still need to plug the receiver into a serial port and an AC outlet. But the receiver has nearly 7 feet of cord, which should be enough to connect it to a PC hidden under your desk.

There is one trap that the Manager mouse will succumb to—power loss. When the built-in NiCad batteries wear out, you'll have to send the unit back to the the company for a battery replacement, the price of which was not determined at press time. After lying idle for more than 60 seconds, the mouse goes into sleep mode to save power; one click wakes it up. According to Numonics, the Manager Mouse will last for about 8 hours of continuous operation before it turns into a blind mouse. To give it back its sight, you'll have to let it recharge overnight. So if you're a heavy mouse user or often find yourself racing against the clock, you'll probably find that much sleep debilitating.

Manager Mouse Cordless
Numonics Corp., 101 Commerce Dr.,

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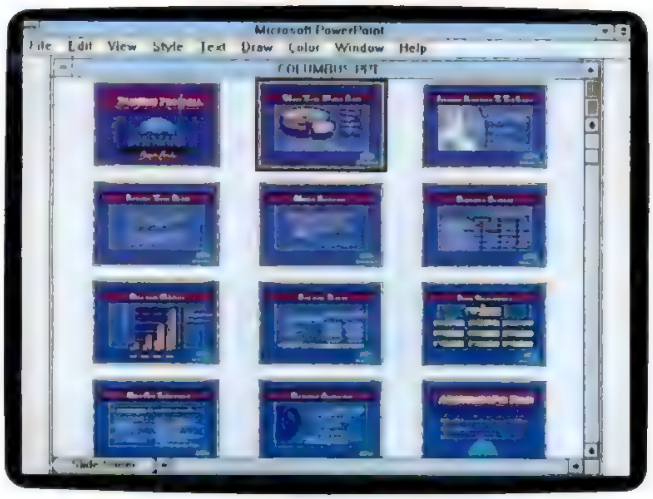

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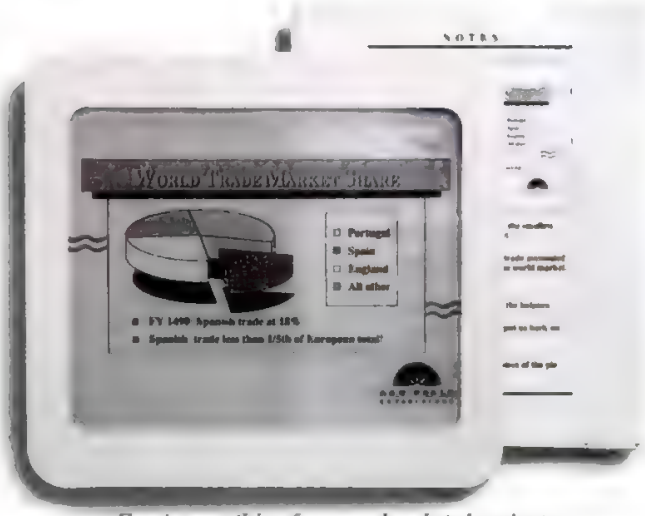

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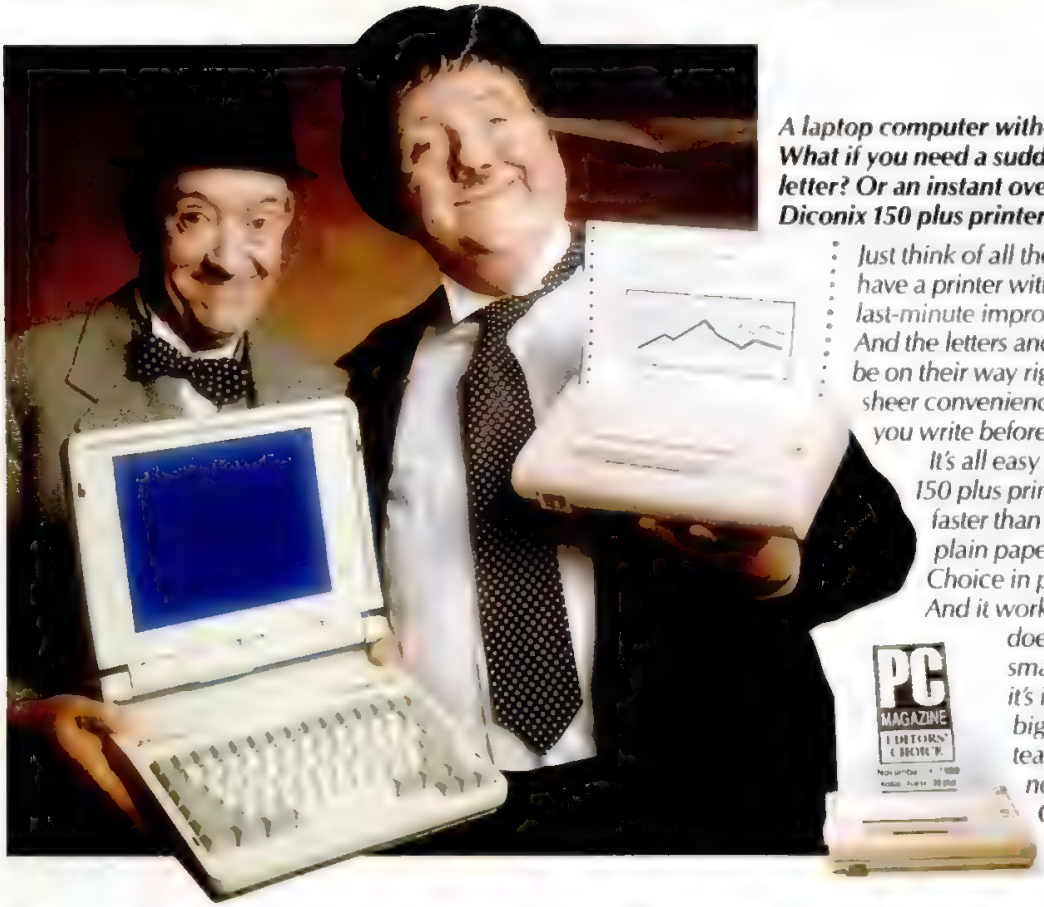

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CIRCLE 363 ON READER SERVICE CARD

EDITOR'S CHOICE

- **Logitech TrackMan Stationary Mouse (trackball)**
- **Microsoft Mouse (mouse)**
- **MicroSpeed PC-Trac (trackball)**

For applications running under a graphical user interface, a mouse is the best input device. The design of most mice makes them better suited to the hand than most trackballs. Mice, particularly those with the "Dove bar" shape (named for the soap), allow the hand to rest pointed down. Most trackballs force the hand to stay bent, which is tiring after a while. And, most trackballs make you reposition your hand whenever you want to press a button. Touchscreens are even more tiring to the arm and are appropriate only in point-of-sale applications. Digitizing tablets are fine for specialized CAD applications but too much for mainstream business use. The mouse is the best supplement to your keyboard. And the best mouse is the Microsoft Mouse.

Nothing beats the Microsoft Mouse. For excellent design, overwhelming application support, and full compatibility, you won't find anything to beat it. And, with a street price of less than $100, you can't go wrong.

Indisputably dominant over its competitors, the Microsoft Mouse wins Editor's Choice for mice, but there are other worthy mouse alternatives. Honorable mentions go to Kensington's $169.95 Expert Mouse for its well-designed features; KYE's $109 Genius Mouse F303, a respectable copy of the Microsoft Mouse; Logitech's $119 three-button Series 9 Mouse ($139 for serial version), and Mouse Systems' new $149 PC Mouse III, which sports improved accuracy for high-end CAD applications.

On the other side of the fence, two new trackball designs solve the ergonomic problems inherent in the rest. And, if the PC community is like the Apple community, we can expect to see about 10 percent of the alternate input device market go to trackballs. For PC users who may opt for a trackball, there are two that win Editor's Choices: the Logitech TrackMan and the MicroSpeed PC-Trac. Each offers a design that's ergonomically designed and each is equipped with an essential Drag/Lock button, so you don't have to try holding down a button while rolling the ball.

The Logitech design lets the thumb roll the ball, while the fingers are free to rest comfortably over the buttons. The only disadvantage to this design is that left-handed users must use their right hands. (By the way, most left-handed people use their right hands for pointing devices anyway.)

The MicroSpeed design slopes down like the Microsoft Mouse's "Dove bar" shape, letting the hand relax rather than forcing it to bend up, as most trackballs do. Also, the buttons surround the ball, allowing each user to find a comfortable position to manipulate both the button and ball elements.

Because of the dominance of the two-button Microsoft Mouse, don't expect to see many applications that take advantage of the middle button on the Logitech and other three-button mice. Lastly, while you can't go too far wrong with most of the mice reviewed here, think twice about some of the very cheapest, particularly those assembled offshore and sold through little-known mail order outlets. These products aren't well made or supported.

fer twice as much opportunity for trouble, since the infrared detector could get buried too. Having used this $149.95 little marvel, however, I'm a convert.

The secret of The Cordless Mouse lies with the detector's cone of vision: 45 degrees in all directions from the center line. You can attach the detector to the side of your monitor with a strip of double sided tape, or put it on top of your modem, and it will see the mouse from any reasonable spot on your desk. Even better, a cordless

Introducing: the MousePen

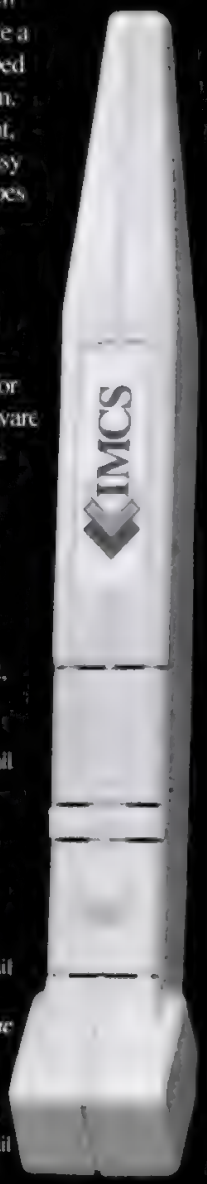
The MousePen actually works like a mouse but is shaped and held like a pen. Unbelievably light, responsive and easy to use, it really does work in just 3" square. The MousePen rests naturally in either hand and is an excellent choice for use with any software that uses a mouse.

The MousePen is available in three styles:

The MousePen for IBM PC or PS/2. With Microsoft compatible driver, $149.00 suggested retail

The MousePen *Portable* For IBM, ultra low power. Includes carrying case. $149.00 suggested retail

The MousePen *Mac* For Apple ADB systems. No driver required. $129.00 suggested retail



actual size

For more information, see your local dealer or call IMCS at 1 800 448-1184

IMCS

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CIRCLE 334 ON READER SERVICE CARD

mouse is less likely to get buried under papers when you're not using it; you can move it to any convenient place without worrying about tangling a cord.

Setup consists of installing two triple A-size batteries in the mouse and plugging the detector into either a serial or mouse port; The Cordless Mouse comes with connectors for both. You then copy the files to your hard disk, and add a command to load MOUSE.COM from your AUTOEXEC .BAT file. Also included is a menu utility for building TSR mouse menus for programs that lack mouse support.

As tested, the mouse failed to show a cursor on the PC Labs test with its own driver, but worked with the *Windows* driver for both the PC Labs test and for *Windows*. However, the driver had no problems with any other programs we tested—including *Word*, Version 5.0, and *Norton Commander*. Practical Solutions says it may be about to replace the drivers, and will look into the problem in any case.

The mouse has a base resolution of 320 ppi, but the driver lets you change sensitivity over a range of about 100 to 1200 ppi. A nice touch is that you can turn ballistic tracking on only as needed by holding down a button on the side of the mouse. The range for ballistic tracking varies depending on the sensitivity setting.

Although Practical Solutions has other mice for the Amiga, Atari, and Macintosh, the $149.95 Cordless Mouse is the company's first input device for the IBM world. And if the price seems a bit steep, it may be worth the premium for being able to mouse around without worrying about tangling the cord.

The Cordless Mouse
Practical Solutions Inc., 1135 No. Jones Blvd., Tucson, AZ 85716; (602) 322-6100.
List Price: $149.95

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CIRCLE 290 ON READER SERVICE CARD

by Mitt Jones

It's not just a mouse, it's a power mouse—the PowerMouse 100 to be exact. From its beginnings last year as a *Lotus 1-2-3* productivity-enhancement tool, this 40-button, 200-ppi renegade has evolved into a general-purpose, programmable mouse capable of working with nearly any program, whether it supports a mouse or not. Although many buyers will want to customize the $249 PowerMouse to suit their own tastes, for those who don't, ProHance has included predefined templates for about 20 applications.

The PowerMouse includes two wide

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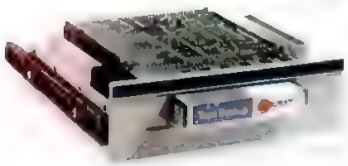

Jumbo also offers an unattended scheduler for backing up at night or on weekends. And it's fully network compatible with Novell®, 3COM®, PC Net®, and optional Xenix®/UNIX® support. Everything is rated high with Jumbo except one–the price! You still get it for an incredibly low price.

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CIRCLE 473 ON READER SERVICE CARD

INTRODUCING WIZ

WIZ is an exciting new productivity tool. It combines the easy-to-use features of a mouse with the power of an intelligent graphics pad to enhance every pointing, tracing and drawing function you do.

And it gives most Mac and PC users a short cut through tedious keystrokes and menu picking steps. So it's easier for new computer users to learn both the system and the software. While experienced users immediately become more productive, powerful and creative.

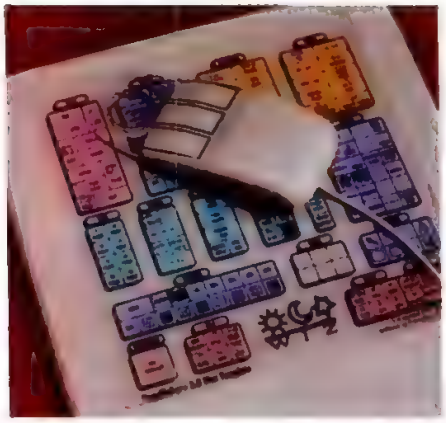
But the most amazing thing about WIZ is that you get it all for a suggested retail price of under $250.

Features/Benefits

6 programmable functions. The three WIZ mouse rocker buttons allow you the flexibility and convenience to program up to four different commands or macros. Two others control your mouse and template clicks.

Speed. WIZ eliminates the need for scrolling through multiple on-screen menus or remembering the many keyboard commands used by software packages. Programmable buttons and templates allow instant access to commonly used software commands.

Pinpoint accuracy. WIZ is the most accurate mouse system on the market, with 1000 dots per inch (dpi) resolution, compared to as much as 400 dpi offered by other mouse manufacturers. The very high accuracy of the pad, combined with the cross-



hairs on the mouse and the optional pen, make WIZ excellent for drawing and tracing.
Reliable. WIZ has no mechanical parts. It is all electronic, so there are no parts to clean or maintain. No rolling ball or moving parts on the mouse. WIZ is the most reliable system you can get.
Adjustable pad scaling. WIZ allows you to define the portion of your intelligent pad's active area which corresponds to your computer screen. This is especially beneficial in drawing and tracing applications.
Templates offer direct access to commands. Optional templates, available for most major programs, fit on top of your intelligent pad. The color-coded WIZ templates place software commands at your fingertips, eliminating tedious pull-down menus and keystrokes.
Software compatibility. Works with most of the popular mouse-driven software. Full Microsoft and Apple mouse compatibility.
Small footprint. It's the same size as an ordinary mouse and pad. 7.5" square active area. The overall size is 9.5" x 11.8".
Easy to install. Works on IBM and compatibles plus Macintosh II and SE computers. WIZ plugs right into your mouse, serial port or ADB, (depending on your system). You're up and running in just a few minutes.
Complete system. WIZ comes complete with a WIZ mouse and intelligent pad, interface cables, drivers, operating system template, User's Guide and a 5-year warranty.
Support. WIZ is manufactured by CalComp, a world leader in computer graphics for over 30 years.

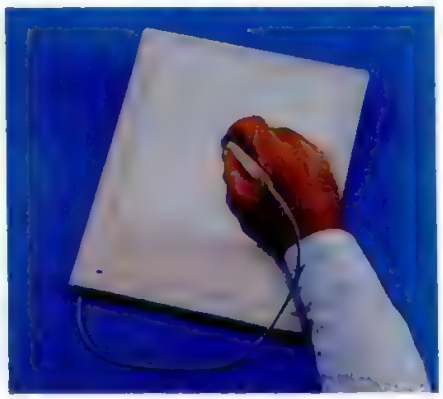
Who can use WIZ?

Anyone who is now using a mouse or thinking about using one including:
Business professionals can use WIZ with all their applications to help save time when creating presentations and business forms, including spreadsheets and graphics.
Graphic artists can use WIZ to assist with the creation of simple to sophisticated designs and graphics.
Electronic publishers, both professional and occasional, can use WIZ to help speed the creation of a variety of professional-looking documents such as newsletters, flyers, pamphlets and stationery.
Engineers and architects can use WIZ as a CAD tool for conceptual designs and technical drawings.
Writers and journalists can use WIZ to assist in the creation of articles, manuscripts or stories.

Options

WIZ Pen

Creative alternative. When you prefer the feel of a pen over a mouse. It's great for menu-picking, drawing and tracing, as well as controlling screen cursor movements. Plugs right into the back of your pad.
2 Buttons. Use the button in the tip to menu pick, draw and trace – can use for all your mouse functions too. The side button allows you to make template command selections.
Suggested retail price of $75



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Enhance productivity. When you want speed and power, use the WIZ mouse or pen and intelligent pad with a template. WIZ comes with a standard template for your computer's operating system. Plus there's a variety of optional templates for the most popular software packages, which makes using packages quick and easy.
Easy to use. The color-coded templates come complete with easy to install software and instructions.

Templates

Over 35 optional software templates are available for most IBM and Apple packages, including:
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WordPerfect
Harvard Graphics
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Claris MacDraw II

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See WIZ today at your local computer store or dealer.

If your dealer doesn't have WIZ in stock, he can order it through our distributor Ingram Micro D by calling **800-456-8000.**

For product information on WIZ call CalComp at **800-458-5888.**

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WIZ

By CalComp

Everything else is just a mouse!

CIRCLE 144 ON READER SERVICE CARD

buttons that correspond to those of less-endowed mice, ten small buttons labelled for operations such as copy, move, and adjust width, and a group of buttons labelled for numeric and mathematical operations. You also get enter, escape, and backspace keys, among others. The PowerMouse can link as many as 240 macros to its 40 buttons. Each macro can be as long as 255 characters. The PowerMouse connects to either a 9- or 25-pin serial port.

Running with its pre-defined key-definition templates, the PowerMouse seems at its best with spreadsheets. To change a *Lotus 1-2-3* column width, for example, you simply point to the column, depress the Width button, stretch or shrink the width by moving the mouse, then release the Width button. Moving or copying ranges of information is just as easy.

For programs that support mice, the proprietary PowerMouse driver includes an emulation of the Microsoft Mouse. The PowerMouse will not work with the *Windows* Mouse driver, but ProHance now provides its own *Windows* driver, as well as a Windows template.

Creating and editing key definition templates with the PowerMouse is relatively simple. Once you've loaded the spreadsheet-like editing utility, you enter macro strings into the appropriate cell. The PowerMouse will also let you record macros from the specific application, though this will not work with all programs.

The PowerMouse documentation is good, but could be better. A mouse so powerful packs a few new concepts, and the manual skimps in some key areas. ProHance, a small company that seems extremely dedicated to improving and supporting the product, reports that new documentation is in the works.

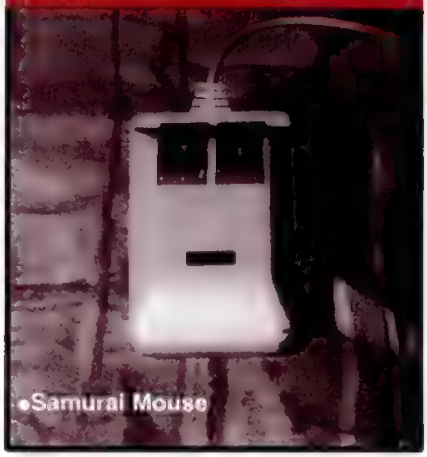
The PowerMouse 100 is a solidly designed and well-supported product. If you spend a significant amount of time revising or formatting worksheets or word-processing documents, you'll probably find the PowerMouse to be an invaluable productivity tool. For those who constantly find themselves tinkering and customizing, the PowerMouse is a dream come true.

ProHance PowerMouse 100
ProHance Technologies Inc., 1307 S. Mary Ave., # 104, Sunnyvale, CA 94087; (408) 746-0950.

List Price: $249; PowerCAD (PowerMouse with *AutoCAD* driver), $325.

CIRCLE 604 ON READER SERVICE CARD

QUALITAS TRADING CO.



•Samurai Mouse

by Margaret Piemonte

The Samurai Mouse from Qualitas Trading implies a mouse with great strength. But, in reality it's your average 200-ppi serial mouse. For $59.95 you get the bare necessities. It comes with a software driver, a manual, and a 9-to-25-pin cable adapter.

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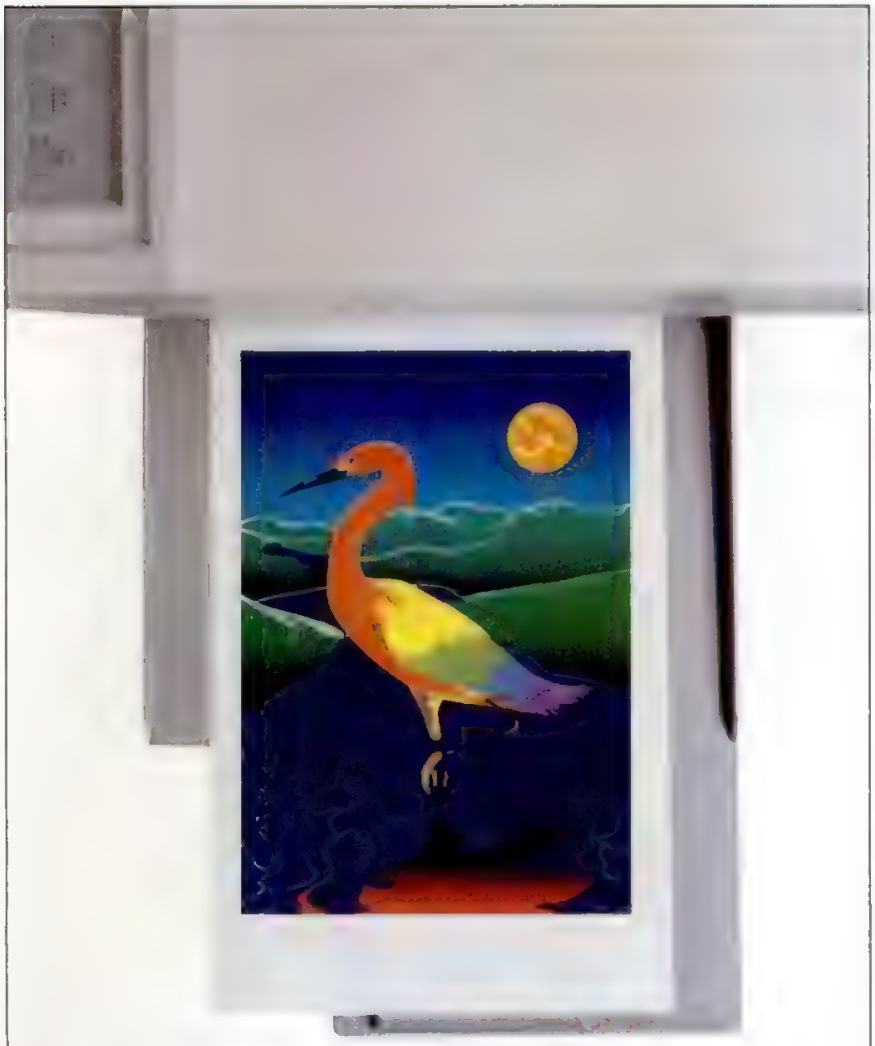

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CIRCLE 218 ON READER SERVICE CARD

Unlike the easy-to-hold "Dove bar" shape, the Samurai has a boxy, less comfortable design. Raised edges on each of the two rectangular buttons help you differentiate between the buttons by touch. And although this design feels unnatural to the curve of the hand, it glides smoothly on the desktop with the aid of four Teflon feet. Response to button-presses is quick, although the buttons are stiff.

Software installation is simple. The installation program copies all the distribution files to a user-specified drive and subdirectory. It also asks whether or not to modify the AUTOEXEC.BAT file to load the driver each time you boot.

The software driver does support ballistic tracking and you can choose one of nine acceleration curves. These curves can be selected by adding a parameter when invoking the driver from the command line.

The mouse does not come with a driver for *Windows*, but it works with *Windows*' internal Microsoft Mouse driver. Also contained on the distribution disk are pop-up menus for several programs, such as *Lotus 1-2-3*, *dBASE III*, and *WordPerfect*.

Don't let the Samuari's coat on the outside of the box let you think you're getting any extras, like bundled software. What you do get is a one-year warranty and ballistic tracking at a low price.

Samurai Mouse
Qualitas Trading Co., 6907 Norfolk Rd., Berkeley, CA 94705; (415) 848-8080.
List Price: $59.95

CIRCLE 605 ON READER SERVICE CARD

SMARTEAM INC.

•SmarTEAM Mouse

by Ann Sherman

Sporting a trapezoid shape and light gray case, the SmarTEAM mouse is nearly

identical to the earliest Microsoft mice as well as Liuski's ProCorp and CMS's Mini Mouse (both reviewed here). SmarTEAM's device offers a three-button-mode option, adjustable tracking, 250-ppi resolution, serial and bus interfaces, as well as Microsoft and Mouse Systems emulations. However, at $75, this critter asks too much for its behind-the-times technology and a warranty that is not on paper.

The SmarTEAM mouse supports the IBM PC, AT, PS/2, and compatible systems. When plugged into the COM1 port of my Compaq 286, the mouse worked well. The tracking sensitivity may be adjusted horizontally, vertically, or both, and you can uninstall the mouse driver from memory at the command line.

The three-button alternative adds some flavor to an otherwise bland package. To activate the option, turn off the computer and, while depressing the far left button, turn the machine back on. Once you load the MSMOUSE driver, all buttons are operable. Although the extra button does add mousing utility, the dated cold-boot mechanism prevents you from switching between two- and three-button applications easily. And if you want to use both modes, you'll find it inconvenient to keep switching drivers into and out of your AUTOEXEC.BAT or CONFIG.SYS file.

The software includes pop-up menus to make the mouse operable with keyboard-driven applications. Among the three supplied, the *Lotus 1-2-3* menu seemed helpful. But the mouse-driven cursor kept provoking the annoying *Lotus* beep, even when just gliding across the menu bar.

And if you have any problems with your mouse, don't look to SmarTEAM for help. According to the company's press contact, SmarTEAM offers no technical support. And no mention of any warranty is made in the poorly organized documentation. Compare this with similarly priced models whose lifetime warranties are expressly stated in the documentation.

Because the SmarTEAM mouse is of the mechanical ilk, lack of a warranty is worrisome. This variety of mouse wears out after moving an average of two miles—too short a life for $75. Not only that, but there are some optomechanical competitors in this year's crop that will save you $10 to $20 and throw in an extra 20 miles of mousing.

SmarTEAM Mouse
SmarTEAM Inc., 19205 Parthenia St., #J,

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CIRCLE 218 ON READER SERVICE CARD

Northridge, CA 91324; (800) 233-7327, (818) 886-9726. **List Price:** $75.
CIRCLE 606 ON READER SERVICE CARD

by Bruce Brown

Got a dead mouse? Suncom sells two serial Microsoft- and Mouse Systems-compatible input devices the company positions as replacement items only. Unfortunately, the $59.99, three-button SunMouse, and the $99.95 MouseTrac don't come with mouse driver software, limiting their usefulness.

The only software included with either product is a Mouse Test program that checks for proper mouse installation and function. The test uses a limited driver good for the test only. Suncom's manuals suggest that you first check your applications programs to see if they include their own mouse drivers. *Microsoft Windows*, for example, includes its own mouse driver and the SunMouse and MouseTrac worked fine with *Windows*.

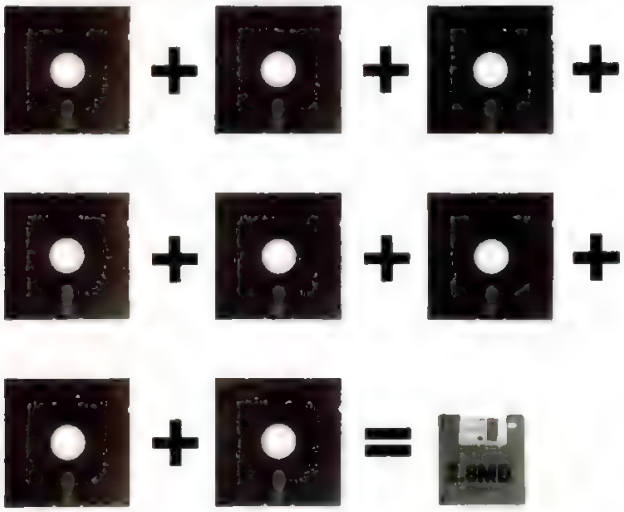
Some other applications have their own mouse drivers, but the majority of programs that can use mice or trackballs look to a DOS-level driver installed via the CONFIG.SYS file or from the DOS command line. Suncom suggests that if you need a driver you should buy either a pop-up mouse program—taking up precious RAM—or purchase driver-utility software.

Of course if you do buy either Suncom product as a mouse replacement you'll probably already have driver software. As long as that software works for a Microsoft or Mouse Systems' mouse the Suncom products should work. But, in that case, you'll probably have older drivers and you should note that newer software often requires updated mouse drivers. Suncom says it doesn't include driver software because it doesn't have the staff to provide software support—a strong indication that you may want to look elsewhere.

The SunMouse is a three-button, 200-ppi, optomechanical unit with a 56-inch cord and a removable 1-inch silicon rubber ball. The cord has a 25-pin serial plug. The SunMouse warranty is for 90 days. Compare this with other units' lifetime warranties.

The MouseTrac has a 104-inch cord with a 9-pin plug and a 9-to-25-pin adaptor. In addition to its 2-inch non-removable phenolic ball, the MouseTrac has three buttons and a locking drag button. Like the SunMouse the MouseTrac is a 200-ppi device with no ballistic tracking; in this case, however, the warranty is good for one year.

Suncom's dependence on other vendors' drivers and comparatively high prices make it difficult to recommend



Megamate 2.8 stores eight times as much data as a 5.25" drive at four times the speed. It handles any 3.5" IBM disk – 2.8MB, 1.4MB, 720KB – and is a cinch to install on any IBM PC, XT, AT or compatible. Megamate 2.8 comes complete with everything you need. So add 2.8MB ED capability the easy way – with Megamate 2.8! Call Micro Solutions today for the dealer nearest you.

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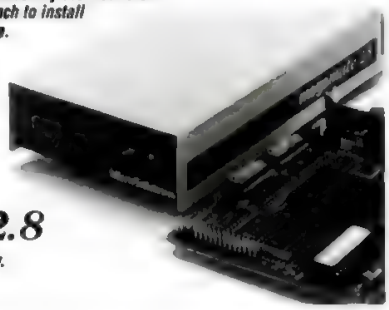

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SunMouse
MouseTrac
Suncom Technologies, 6400 W. Gross Point Rd., Niles, IL 60648; (708) 647-4040.
List Price: SunMouse, $59.99; MouseTrac, $99.95.

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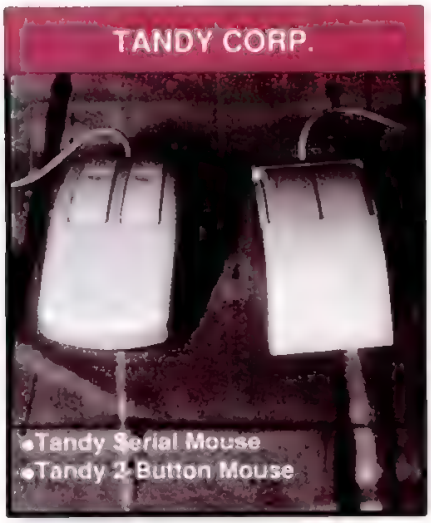

ALTERNATE INPUT
MICE AND TRACKBALLS

by Ed Perratore

Tandy does a good job of providing a range of PC and related products through its popular Radio Shack stores, and mice are no exception. Also no exception is the company's tendency to target current Tandy users, particularly *DeskMate* aficionados, thus making it a bit discouraging for the rest of us.

The company's $49.95 2-Button Mouse can connect to the mouse port of IBM PS/2s and other machines that have built-in mouse ports. Tandy's recent computers show the company's involvement in the increasing alternate input trend: many have dedicated mouse ports. Its 200-ppi resolution does the job for many applications. The drivers—plus an included memory-resident utility, CPANEL.COM, and a Microsoft Mouse emulation—provide enhanced sensitivity and ballistic tracking; these two features push the virtual resolution up to 19,000 ppi if your software isn't already using its own drivers.

If you're a Tandy PC owner, you already have the MOUSE.COM and MOUSE.SYS drivers, as well as CPANEL.COM; they come with Tandy's MS-DOS. If not, you'll need to special-order them on a free disk after you buy the mouse. Believe it or not, they don't come with the mouse.

Once you've taken care of these pesky matters, you'll find the mouse responsive to the touch. But some users may find its crescent-moon shape uncomfortable.

More pleasing to the palm may be Tandy's older Serial Mouse ($49.95). This model offers the same resolution and functionality as the 2-Button, but is mechanically rather than optomechanically controlled. It connects to 25-pin serial ports.

Either model is a worthwhile choice for Tandy users and for anyone who doesn't expect great things from a mouse, including comprehensive documentation. But even though the drivers aren't readily available, at $49.95 the products may be hard to resist. ■

Tandy Serial Mouse
Tandy 2-Button Mouse
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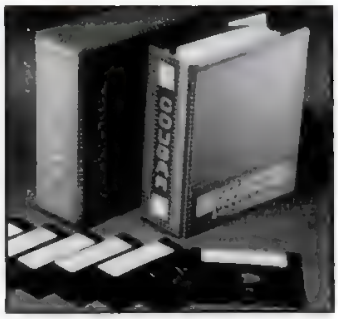

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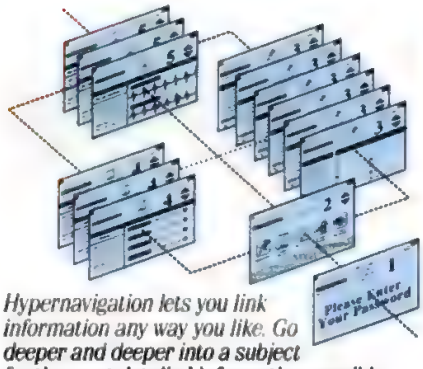
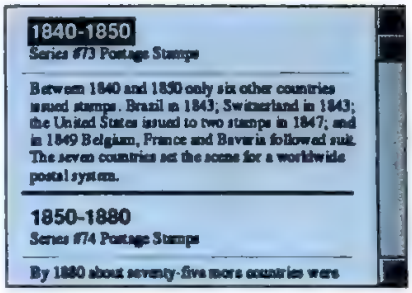
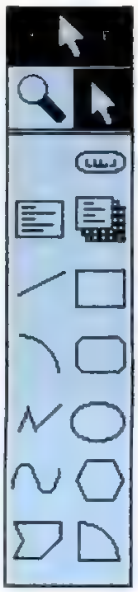


Hypernavigation lets you link information any way you like. Go deeper and deeper into a subject for the most detailed information possible.



Select a text field and write your heart out with full text editing capabilities including paragraph and character formatting.



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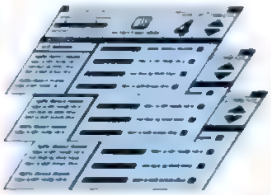

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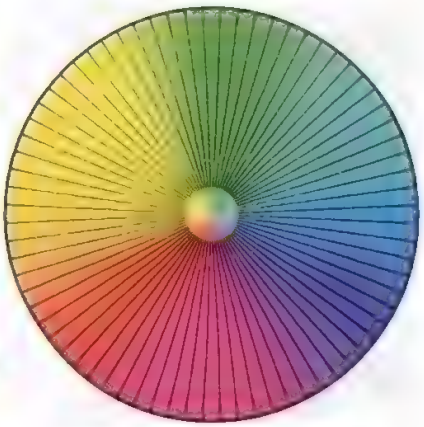
```
Script  Edit  Find
to handle buttonup

  ask "Enter new index name"
  if it is not null and it is not cancel
    put it after text of field "index"
    activate menuitem "Show Index"
  end if

end buttonup
```

OpenScript® is an object-oriented programming language that's easy to learn and use. It's perfect for building more comprehensive Windows applications.



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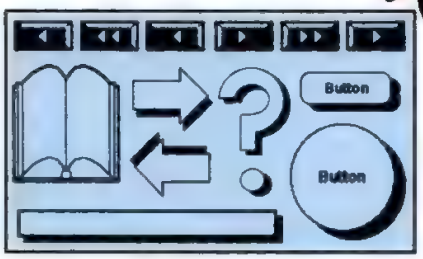

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SOLVING YOUR IMAGE PROBLEMS:

Three Conversion Utilities for Graphics Files

Even the prettiest picture isn't worth much unless you can get it into a workable format for editing, printing, or incorporating into your documents. Three graphics file conversion utilities—*DoDOT*, *The Graphics Link Plus*, and *HiJaak*—act as interpreters in the Babel of graphics file standards.

by Robin Raskin

Desktop publishing programs, scanners, paint programs, drawing programs, word processors—all have their own expectations about graphics files. Though the PC industry has settled on a couple of standards (.PCX and TIFF are the most common for bitmapped graphics), the images you want won't always come in these formats. Moreover, today much graphics work is done on Macintoshes, and getting files from Macintosh formats into your PC can be a job of its own.

Most graphics applications can read and write several different formats, and some, such as *PageMaker*, are quite adept at speaking multiple formats. But built-in conversions are limited in their flexibility, especially when it comes to converting color images to black and white. In addition, wrinkles in standards, especially with TIFF files, can make importing even compatible formats a trial.

REVIEW CRITERIA

If you're dependent on images from widely varying sources, you need a Swiss Army knife—a graphics file conversion utility that can accept images in a large number of formats and translate them into formats you can use. In this article, we review three such packages, all of which must support at least nine different bitmapped file formats, including the following:

- .PCX, a format pioneered by ZSoft's *PC Paintbrush* and now widely supported by PC graphics programs
- TIFF (Tagged Image File Format), a nonproprietary format popular with desktop publishing programs and scanner manufacturers
- EPS (Encapsulated PostScript), the standard for bundling bitmapped graphics with PostScript code
- GIF (Graphics Interchange Format), CompuServe's well-defined platform-independent color graphics format
- *MacPaint*, the standard for bitmapped graphics in the Macintosh world.

PC EDITOR'S CHOICE

•The Graphics Link Plus

In theory, these graphics file conversion utilities should be able to handle all the conversions we throw their way. In practice, subtle complexities in formatting and certain combinations of conversions often spell failure.

The one that gets it right most often is *The Graphics Link Plus* from HSC Software. Its flexible approach proves a winner, producing the best output and giving you the most options. In particular, its choice of dithering algorithms make it the hands-down best for reducing color images to print on black-and-white output devices, and its scaling facility makes it a snap to figure out the percentage of enlargement or reduction you should use for any given resolution.

DoDOT can be a good second choice for a user of *PageMaker* or other *Windows* programs. Though its design hampers its handling of color images, the program is unique in its ability to handle 256-color TIFF and color .EPS files, and its dithering algorithm gives good results in most cases.

All the packages support additional types of graphics files, including *Windows*- and *GEM*-specific varieties. All of them also come with screen-capture utilities (see "Hold It! Screen-Capture Software Saves the Moment," *PC Magazine*, April 24, 1990) to handle images that aren't supported directly. Be aware, though, that direct conversion, even in multiple steps, is preferable because screen capture limits the image to the size and resolution of your graphics monitor.

We chose to focus on packages that handle a large number of formats, but if most of your work is confined to .PCX and TIFF, check out Inner Media's *Collage Plus*, which offers fine-tuned control for these formats. Equally worthy of consideration is Anderson Consulting's *Tiffany Plus*, a *Windows* application that concentrates on .PCX, TIFF, and *Windows*-specific formats. Finally, Symsoft's *Hot Shot Graphics* supports a number of conversions and offers good image-editing tools into the bargain.

Note that all these packages are intended primarily for converting bitmapped (also called raster) graphics files, in which the image is represented as a series of dots, or pixels. Recently, several utilities have emerged that are capable of translating vector-based file formats, in which images are represented as a series of geometric entities that can be scaled and transformed without losing resolution. Micrografx's *XPort* and Zenographics' *Import* are two that were announced at the time of our review, and a new version of *HiJaak* that handles more vector formats is expected by the time you read this. Look for a review of these packages in a future issue.

COLOR TO MONOCHROME

Graphics file conversion programs serve a purpose beyond simple translation from one format to another; they also prepare color images for monochrome output. *DoDOT* and *The Graphics Link Plus* let you convert 16-color or 256-color images to a corresponding number of gray levels. This gives the most accurate rendition of the image, but as of today, relatively few programs (*Ventura Publisher* 2.0 and *PageMaker* 3.0 are among them) support gray-scale images, and in any case laser printers are capable of printing only one shade of black. In practice, therefore, converting color to monochrome requires *dithering*, in which the colors of the original image are replaced with dot patterns of greater or lesser density, giving the appearance of gradual shading.

Dithering is, at best, an inexact science. When dithered, color images tend to lose details, and moiré patterns (an unaesthetic swirling in the patterns of dots) can occur when dithering algorithms go awry at certain output resolutions. *DoDOT* and *HiJaak* each offer a single one-size-fits-all dithering algorithm that may or may not produce good results on a particular image. By contrast, *The Graphics Link Plus* offers 11 different algorithms that you can select individually to suit different resolutions and output devices.

These utilities also let you scale or rotate the images, invert the pixels on black-and-white images, and store TIFF files in either compressed or uncompressed format. On Macintosh conversions, you usually have the option of adding the header that the Macintosh expects to see for its graphics files.

PART SOFTWARE, PART ART

Getting the most out of file conversion software requires some skill. Each image is a unique exercise: you'll need to use different techniques in light of the target application and intended output resolution, and you may need to do your conversions in multiple steps. Be aware, also, that *PageMaker* can degrade the quality of imported TIFF and .PCX images on printing, and that it tends to change their sizes as well. There are no surefire rules, but with practice and patience—and the help of these conversion utilities—you'll be well-equipped to handle the inevitable difficulties thrown your way.

DoDOT

DoDOT ($129) from Halcyon Software has one great advantage over its competitors: it's a *Microsoft Windows* program that can run concurrently with *PageMaker* or other *Windows*-based graphics packages, making it relatively easy for you to size, convert, and place an image in a document without ever leaving the *Windows* environment.

With *DoDOT*, you must open the source file to display it on the screen before you can convert it (you use the Save As option to indicate the destination file format, then supply any additional information in a conversion-specific dialog box). This

approach has its advantages. Since you can see the image, it's fairly easy to know right off if the conversion is behaving appropriately. Plus, you can size and manipulate your image before converting it. A handy Fit to Window command resizes the display window to fit the image, making it easy to rescale large or small images to the size you need for placement.

The disadvantage is that displaying a high-resolution graphics image on the screen is slow going; converting a single image can easily take double the time required with other programs that directly convert the files without this extra step. *DoDOT* has no batch conversion capabilities, so converting multiple files can be a considerable chore.

Moreover, *Windows*' limited display capabilities often confound the process. The standard *Windows* screen drivers display only 8 primary colors (though drivers are available to support 16- or 256-color displays). If you're converting a 64-gray-scale or 256-color image, you have two choices, neither ideal. If you turn dithering on, you get a reasonable monochrome approximation on the screen, but then the output file is dithered as well, which may not be what you want. On the other hand, if you turn the dithering option off, you get a faithful-to-the-original conversion, but the screen display looks like op-art gobbledygook. This is one instance in which "what you see is what you get" isn't necessarily the best solution.

QUALITY CONVERSIONS

DoDOT is solid in its conversion facilities, supporting all .EPS, TIFF, .PCX, and .GIF formats be they monochrome, gray scale, or color. In fact, *DoDOT* is the only program in this review that supports conversion to full 256-color TIFF and .EPS formats. You can have the option of using either of the two major TIFF compression schemes (Packbit or Lempel-Zev-Welch), and you can write TIFF files with either the Intel or Motorola specification.

As you'd expect of a *Windows* program, *DoDOT* supports the *Windows* Clipboard (.CLP), *Windows* 3.0 Bitmap (.BMP), and *Microsoft Paint* (.MSP) formats. Other esoteric conversions include RIX *EGA Paint* (.SCR) and *Dr. Halo* (.CUT). The only major omission is support for *WordPerfect* Graphics format (.WPG) files, but *WordPerfect* users can get around this by using the *Windows* Clipboard (.CLP) file format.

There are a few minor irritations. For example, .EPS appears as an option when you choose File Open from the menu, though in fact .EPS files cannot be opened and read, only written. *DoDOT* also does not support the inclusion of a Mac-style file header when it converts an image to *MacPaint* files, requiring you to use Apple's File Exchange to convert it before you can use it with Mac applications.

This 640 by 480 by 256-color .GIF image was converted to color .EPS format and printed on a QMS ColorScript 100 printer using *DoDOT*, the only program we reviewed that supports color PostScript output. Note, however, that some colors were lost in the conversion because the number of colors is limited by the default *Windows* screen driver, which shows only 8 colors. If you choose to use dither patterns to simulate the 256 colors of the original image, the output file is dithered as well; you can avoid this substitution, but only at the cost of making the screen display unreadable.

Screen image

Printer output

PHOTOGRAPHS: THOM O'CONNOR

ATTRACTIVE DITHERING

To reduce color and gray-scale images to black and white, *DoDOT* uses a single dithering algorithm with a 4 by 4 error-distributed matrix. The results are usually attractive, although our complex 256-color to black-and-white dithered test image came out of *DoDOT* looking very confused. *DoDOT* lacks black-and-white inversion capability, so you may get disappointing results when converting color images to monochrome.

Like the other programs reviewed, *DoDOT* offers screen-capture capabilities, but since it lets you capture a single window or a portion of the screen as well as the full screen, it is exceptionally well suited to *Windows* screen capture. The program also includes a print utility that lets you specify the size in inches, centimeters, or pixels, and, of course, lets you print on any printer for which there is a *Windows* printer driver.

Though the current version of *DoDOT* is marked for use with *Windows* 3.0, the folks at Halcyon are readying a *Windows* 3.0-specific version that will support an array of new formats, including the vector-based *Windows* Metafile and Mac PICT formats, as well as the *WordPerfect* Graphics format and the CCITT fax format. The new version will also allow you to display multiple images and perform batch conversions. In the meantime, *DoDOT* remains a congenial com-

GRAPHICS FILE CONVERSION SOFTWARE: SUMMARY OF FEATURES

Products listed in ascending price order

	DoDOT	PC The Graphics Link Plus	HiJaak
List price	$129	$149	$149
CONVERSIONS			
.PCX (from/to):			
Black-and-white	■/■	■/■	■/■
Gray-scale	■/■	■/■	■/■
16-color	■/■	■/■	■/■
256-color	■/■	■/■	■/■
TIFF (from/to):			
Black-and-white	■/■	■/■	■/■
Gray-scale	■/■	■/■	■/■
Color (256-color palette-based)	■/■	■/□	□/□
Color (RGB)	■/■	□/□	□/□
Other formats (from/to):			
.CUT (Dr. Halo)	■/■	■/■	■/■
.EPS (Encapsulated PostScript)	□/■	□/■	□/■
.GIF (GIF)	■/■	■/■	■/■
.IFF (Amiga)	■/□	□/□	■/■
.IMG (GEM)	■/■	■/■	■/■
.MAC (MacPaint)	■/■	■/■	■/■
with/without header	□/■	■/■	■/■
.MSP (Microsoft Paint)	■/■	■/■	■/■
.PIC (Grasp and Pictor)	□/□	■/■	□/□
.PIC (Lotus 1-2-3 Graphics)	□/□	□/□	■/■
.WPG (WordPerfect Graphics)	□/□	■/■	■/■
Fax formats	□/□	□/□	■/■
HPGL (HP Graphics Language)	□/□	□/□	■/■*
PCL (HP Printer Control Language)	■/■	□/□	■/■
IMAGE CONTROL OPTIONS			
Black/white inversion	□	■	■
Color-to-B&W conversion:			
Dithering	■	■	■
Thresholding	□	■	■
Controls size of converted image	■	■	■
Converts ASCII text to fonts	□	■	■
TIFF compressions (Packbit/LZW)	■/■	□/■	□/□
OPERATION			
Batch conversion	□	■	■
Macros	□	■	□
Keeps conversion error log	□	■	□
Uses expanded memory	□	□	□
Uses disk-based virtual storage	■	■	■
MISCELLANEOUS			
Runs under Microsoft Windows	■	■	□
Screen capture	■	■	■
RAM required	None	34K	48K
Graphics file viewer	■	■	□
Prints graphics files:			
Epson (dot matrix)	■	■	□
HP LaserJet	■	■	■
PostScript	■	■	■
Color PostScript	■	□	□

PC—Editor's Choice ■—Yes □—No
* Only if the source file is Lotus .PIC.

panion for your *Windows* desktop. ***DoDOT***, Halcyon Software, 10297 Cold Harbor Ave., Cupertino, CA 95014; (408) 257-0812. **List Price:** $129. **Requires:** IBM PC, XT, AT, PS/2 or compatible, 640K RAM, mouse, DOS 3.0 or later, *Microsoft Windows* 2.11 or later. **In Short:** The only *Windows*-based program in the group, *DoDOT* does quality conversions, and it's the only one of the bunch that proved capable of 256-color TIFF and color .EPS conversions. But its design slows multiple conversions and hampers its on-screen color capabilities.

CIRCLE 401 ON READER SERVICE CARD

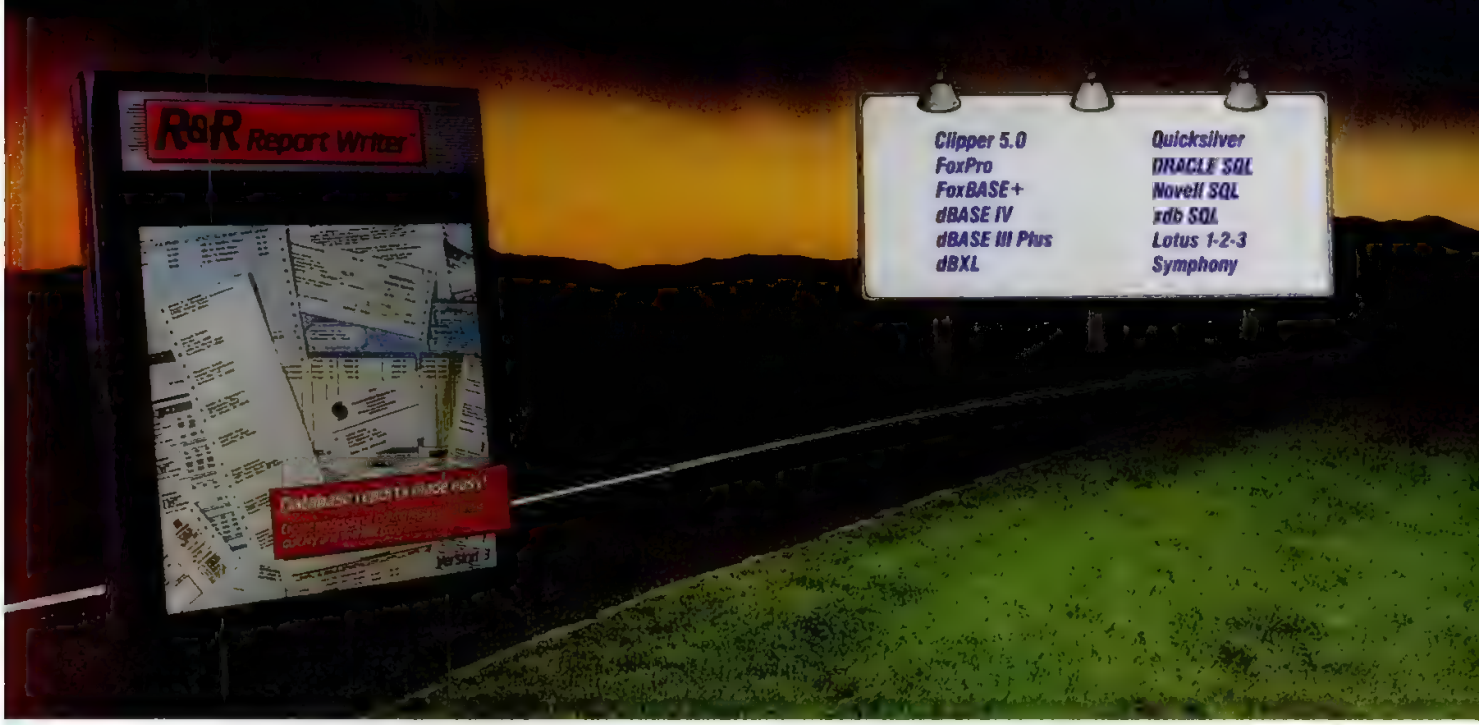
The Graphics Link Plus

Though its appearance is not very glamorous, *The Graphics Link Plus* (*TGL Plus*) is a rousingly good file conversion utility. In addition to supporting almost all major file formats, this $149 program distinguishes itself by its flexibility and the quality of its conversions.

Unlike other file conversion programs that lump scaling, dithering, and conversion into one inextricable process, *TGL Plus* separates these activities into different actions. As a result, using it can be somewhat involved. Before you can do anything, you must first indicate the source and target directories for your files (a task all too easily forgotten if you keep different types of files in different directories) and then specify the nature of the conversion. Only then does a list of source files appear; at this point, you can inspect them for qualities such as color and size, reverse them, view them on the screen, or tag them for batch conversion.

Other options such as dithering and scaling are chosen on separate menus. Each time you dither or scale a file, *TGL Plus* changes the file's name to reflect the process. If you dither an image called PRINCESS.PCX using the Floyd-Steinberg algorithm, the destination file is named FS_PRINC.PCX. Scaling this new image would result in a file named S_FS_PRI.PCX. While this convention makes sense, things quickly get cryptic.

In return for this effort, however, you get an extraordinary degree of control over the appearance and quality of the final image. Our testing script, for in-



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TESTING THE CONVERSIONS

PC LABS

***The Graphics Link Plus* offers the best conversions, especially when they require dithering from color to black and white. But *DoDOT* holds the prize for color TIFF and .EPS support.**

To test the quality and capability of these programs, we performed six test conversions using a number of different images in a variety of formats and resolutions.

In each case, we attempted to duplicate the quality of the original. This meant preserving as many colors or shades of gray as possible or dithering the image to black and white if necessary. When it was impossible to convert directly from one file format to another, we took the requisite interim steps.

To check the integrity of the converted file, we imported each one into a desktop publishing application. We used *PageMaker* for all formats except .IMG; the latter files were imported into *Ventura Publisher* instead.

	Source	Target	DoDOT	The Graphics Link Plus	HiJaak
Test 1:	[illegible]	[illegible]	The conversion posed no problems.	The conversion posed no problems	The conversion posed no problems.
Test 2:	320 by 200 by 16-color .GIF file	Color or black-and-white .EPS format	The 16-color source image was converted successfully to color .EPS, but displaying it properly on the screen required it to be dithered down to the 8 colors supported by *Windows* (see review).	The program does not support color EPS The source image had to be dithered to black and white before being converted to EPS format, and the results were excellent.	The program does not support color EPS The source image was dithered to black and white during conversion, but the results were unattractive
Test 3:	640 by 480 by 256-color .GIF file	256-color TIFF format	The 256-color source image was converted successfully, but displaying it properly on the screen required it to be dithered down to the 8 colors supported by *Windows* (see review).	This program does not support output to color TIFF The source file was converted to 256 shades of gray instead Alternatively, the source file can be dithered before conversion The Burkes error-distributed dithering algorithm proved best for retaining the detail of the original	Converting the 256-color source image required a patch (1 1D) Even with the patch, however, the product could not output to 256-color TIFF Consequently, we dithered the image to black and white, a process that took place automatically during conversion
Test 4:	256-color TIFF file	256-color .PCX format	The 256-color TIFF source image required dithering during conversion, either to a black-and-white .PCX file or to an 8-color .PCX file.	The program could not perform this conversion because it does not support 256-color TIFF.	The program could not perform this conversion, even with the 256-color patch (1 1D).
Test 5:	256-color .PCX file	Black-and-white .IMG format	The 256-color image was dithered to black and white during conversion.	The 256-color PCX image had to be dithered before being converted to the black-and-white .IMG format.	Converting the 256-color source image required a patch (1 1D) The colors were dithered to black and white during conversion
Test 6:	256-gray-scale TIFF file	Black-and-white .EPS format	Since the default *Windows* environment does not support 256 shades of gray, the image could not be viewed except by dithering to black and white (see review) The converted image had many dark areas.	The 256-gray-scale TIFF image had to be dithered before being converted to EPS The Floyd Steinberg filter dithering algorithm produced a beautiful image that retained the richness of the original	Converting the 256-gray-scale TIFF image required a patch (1 1D) The output was dithered to black and white during conversion, but the light areas in the original were converted to dark in the destination file no matter what command line arguments were used

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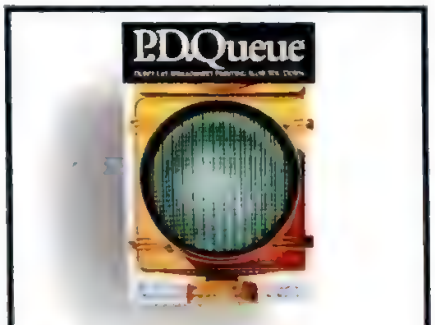

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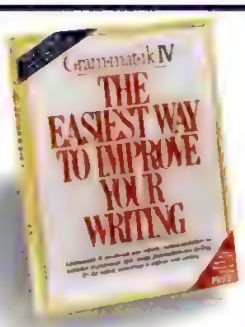

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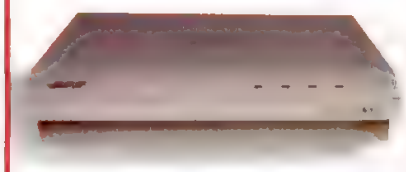

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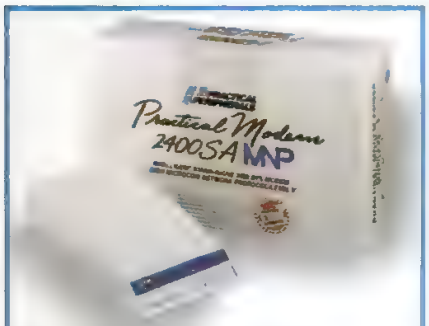

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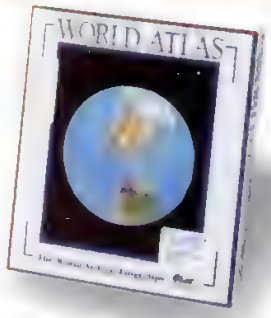

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stance, involved converting a 640 by 480 by 256-color .GIF file to a gray-scale TIFF file. *TGL Plus* complied beautifully, producing a photorealistic result. We then dithered the file using the Stucki dithering algorithm to create output that best kept the artistic detail of the original .GIF image. None of *TGL*'s competitors came close to matching it.

RICH IN OPTIONS

TGL Plus is bountiful in conversions: it supports 19 different bitmapped file formats, including all the majors—plus *Dr. Halo, Show Partner, Lotus Manuscript, WordPerfect Graphics, ColoRIX*, and *Grasp*. You can convert any of these to black-and-white .EPS for use in PostScript documents; the .EPS conversion creates a bitmapped file that appears in your target application as a gray bounding box with header information. The program handles 256-color and gray-scale .GIF and .PCX images without problems, but it failed when tested with a 256-color TIFF file.

TGL Plus is equally rich in options for customizing your output. It is the only program in this review that lets you adjust the brightness of a gray-scale TIFF image. It also lets you change the byte order of TIFF files to suit Intel (IBM-compatible) or Motorola (Macintosh) processors, and you can compress your TIFF files by the Lempel-Zev-Welch method. You can add Apple headers to *MacPaint* files, and you can toggle between today's .PCX format and older .PCX formats without color palette information.

TGL Plus turns dithering into an art. The dithering menu offers you no less than 11 different dithering algorithms. Some are best for converting color images, others for gray scale. Some are optimized for screen display, others for laser output, and still others for dot matrix. The choice is wide enough to let you make even your most complex images look good with only a little experimentation. As a bonus, a tracing utility turns color images into black-and-white bitmapped line art; very handy if your auto-tracing utility doesn't work with color images.

Scaling is another area in which *TGL Plus* excels. The program's sophisticated design makes it easy to choose the right scaling factor for the resolution of your image. For instance, a 640 by 480 gray-scale image is about 2 inches by 1.5 inches in size at a 300-dot-per-inch resolution. Increasing the scaling factor by 50 percent increases the size of the image to 3 inches by 2 inches. To take the same image and print it at the same size on a typesetter, you need simply change the resolution setting to 1,240 dots per inch; *TGL Plus* immediately determines that you need to scale the image by nearly 300 percent to retain its size. You can change horizontal and vertical resolutions independently if you choose.

Since *The Graphics Link Plus* reads but does not write 256-color TIFF files, this rather complex 640 by 480 by 256-color .GIF image had to be dithered before being converted to black-and-white TIFF. We used the Burkes error-distributed dithering algorithm—one of the 11 dithering options that *TGL Plus* offers—which we found best preserved the original detail. *TGL Plus*'s well-designed scaling functions made it easy to scale the dithered image to print at double its original size on a laser printer at 300 dots per inch. After conversion, the final TIFF image was printed on a PostScript printer using *TGL Plus*'s print utility.

Screen image

Printer output

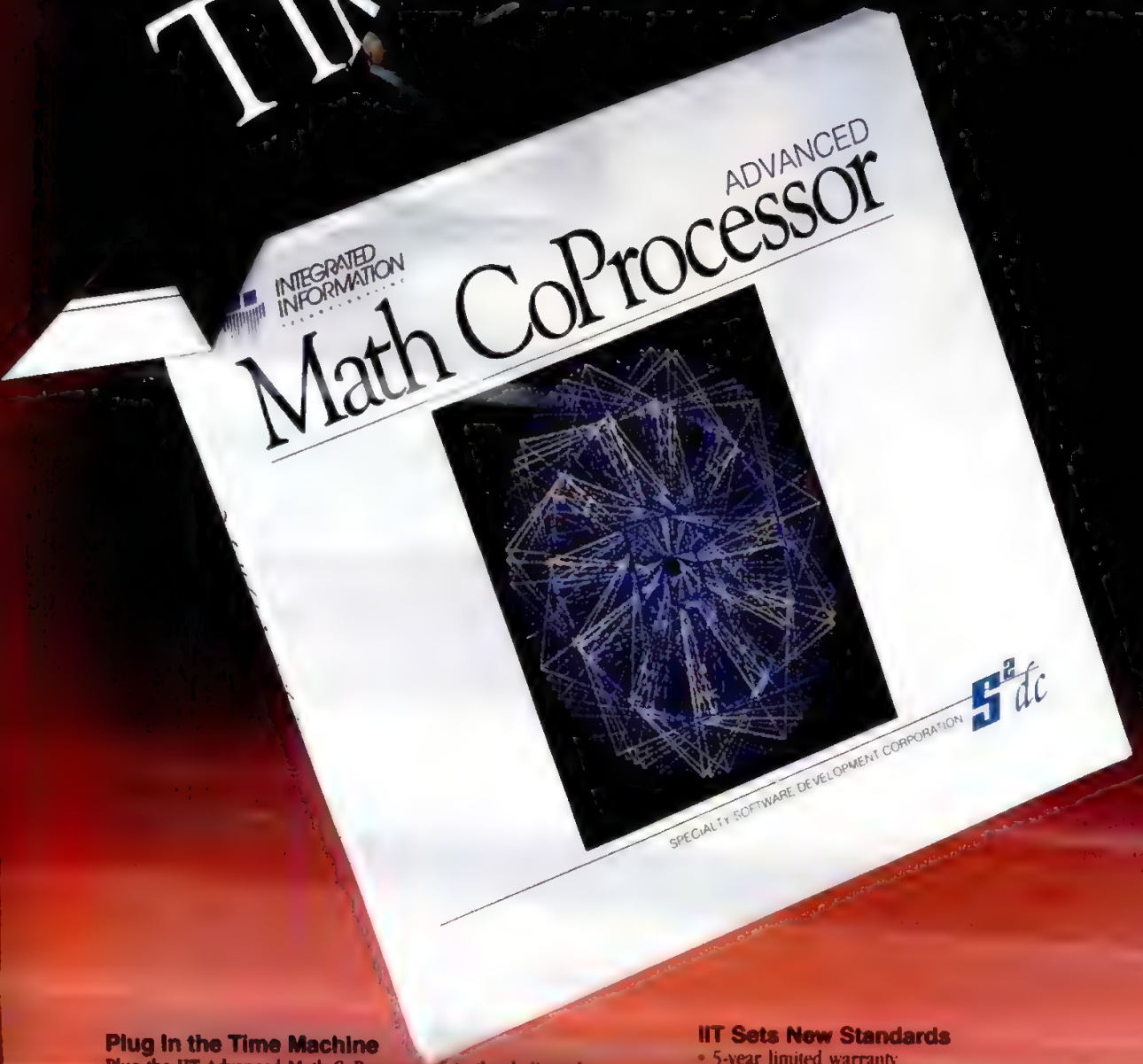
ASSORTED UTILITIES

Though you have to pretend to convert a file in order to use it, *TGL Plus*'s built-in viewer does a terrific job of checking the integrity of your conversions. It's slow, but in return it can show images larger than screen size (though to do this it must often lower the screen resolution, distorting the sizing). Its print utility lets you print images individually or in batch, on HP LaserJet, PostScript, or Epson-compatible dot matrix printers.

A bagful of utilities rounds out this solid performer. There's a powerful (but totally undocumented) keystroke-recording macro function. There's a program to convert ASCII text files to .PCX images using a selection of fonts. There's a utility that checks the headers of TIFF files—something that could prove enormously helpful the next time your graphics program chokes on an unrecognized file. There's also a Rotate utility for .PCX images, as well as a utility to integrate a color palette into older-format .PCX files that don't contain this information. There are even screen-capture programs for both DOS and *Windows*, though these aren't documented in the manual.

Despite its rough edges, *TGL Plus* is the best and most versatile graphics file conversion utility you can buy. If you routinely convert be-

TIME MACHINE



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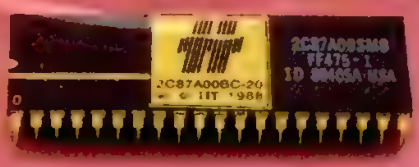

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tween many file formats, strip color from images for desktop publishing, or scale your images for output at different resolutions, you won't want to be without it.

PC EDITOR'S CHOICE

The Graphics Link Plus, HSC Software, 1661 Lincoln Blvd., #101, Santa Monica, CA 90404; (213) 392 8441. **List Price:** $149. **Requires:** IBM PC, XT, AT, PS/2 or compatible, 384K RAM, graphics adapter, DOS 2.0 or later. **In Short:** With many options, including 11 different dithering algorithms and uniquely flexible scaling capabilities, *TGL Plus* offers unsurpassed control over the quality and nature of your conversions.

CIRCLE 402 ON READER SERVICE CARD

HiJaak

HiJaak ($149) was the first major commercial graphics file conversion program for the PC, and it's still the hands-down winner for "most conversions in a single package." But this old grandad is really starting to show its age, mainly in its skimpy user interface and poor control over many aspects of the conversion process.

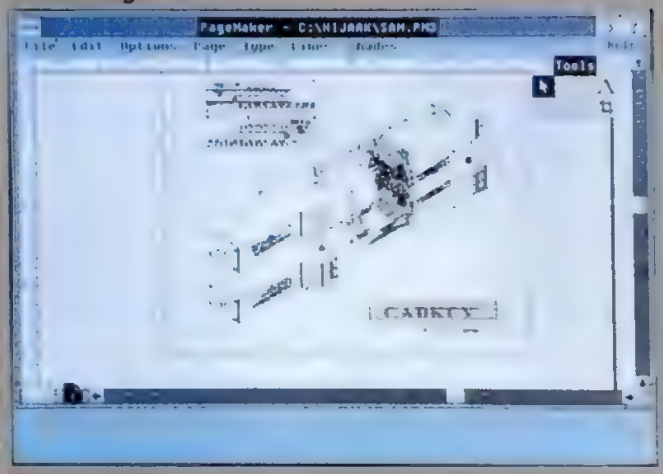
HiJaak contains both file conversion and screen-capture components. Each component can be run separately either from an easy-to-use menu shell or from the command line (which lets you automate multiple conversions using batch files and lets you specify particular options on individual conversions). When in menu mode, the conversion program shows a split-screen display, with the source file on the left and the destination file on the right.

Unfortunately, the menu mode does not let you use many of *HiJaak*'s options, so if you want the best results you'll have to leapfrog between menu mode and command line mode to get the job done properly. For example, the only way I could create an .EPS image that could be placed into *PageMaker* was to use the –NFF switch on the command line, which disables page eject. At the very least, the menu mode should let you specify these command line options.

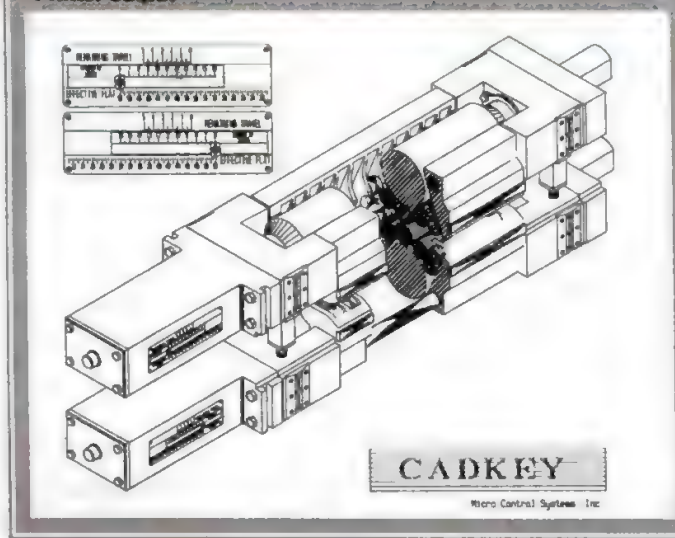
The screen tells you the resolution and color of the source image but leaves you in the dark about what it's doing to the destination file. Color images can be dithered to black and white with a command-line switch; otherwise, *HiJaak* tries to reproduce the colored image in the new format, a task at which it often fails. You can control the image size only on bitmap-to-vector conversions; converted bitmapped images can be sized only by the target application.

This drawing began in *CadKey*, a three-dimensional CAD package. It was written as a vector-based HPGL file to be imported into *PageMaker*, but since *PageMaker* has a 64K limit on all imported files except .EPS files, it could not accept the 267K HPGL file directly. With *HiJaak*, we were able to convert the HPGL file to an .EPS file containing the vector information, which was imported without difficulty. *HiJaak*'s handy PGL2EPS batch file merges a bitmapped TIFF image into the .EPS file. This lets you see the image as you're placing it in your *PageMaker* document, instead of the proverbial gray bounding box.

Screen image



Printer output



MANY CONVERSIONS

Though its user interface is Spartan at best, *HiJaak*'s list of conversions is comprehensive. It supports all the major bitmapped formats, plus a number of oddballs such as *PrintMaster*, *NewsMaster*, and the Commodore Amiga .IFF format. It reads and writes the proprietary formats for a host of fax boards, letting you convert documents for transmission without the intermediary scanning step. It can handle *MacPaint* files with or without the Apple header, which makes it well suited for bidirectional file transfer between PCs and Macs. It even accepts ASCII text, using its own high-resolution fonts (or PostScript code for .EPS) in the conversion to a graphics file.

HiJaak has limited support for vector formats such as HPGL and Lotus .PIC; you can convert between any two supported vector formats, or from any vector format to any supported bitmapped format. The program is unique in its ability to write both bitmapped and vector information to .EPS files. A utility lets you bundle a TIFF image within an .EPS file, which you can view during placement instead of the gray bounding box you'd otherwise see in *PageMaker*.

MANY PROBLEMS

Our review process dredged up a good share of problems, however. First of all, we discovered that the current shipping version of *HiJaak* does not support 256-color .GIF and TIFF conversions. Although Inset Systems does have a patch (*HiJaak* 1.1D)

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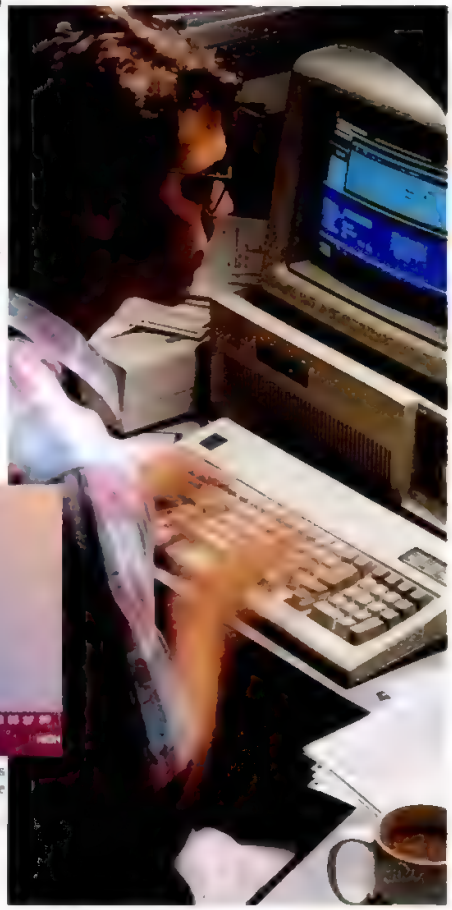

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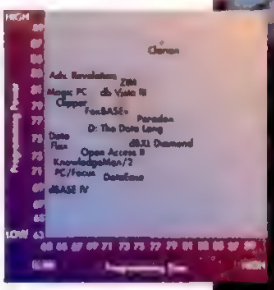

Here's what American corporations in a PC Week survey thought of the power and ease of use of Professional Developer vs. competitors

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MOVING?

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that is supposed to support these conversions, the company doesn't believe that most users will need it, so you won't get it unless you ask for it. Even with the patch, 256-color TIFF conversions proved beyond the program's powers. Moreover, *PageMaker* choked on the 256-color .PCX files that *HiJaak* created. And the 16-color .PCX file I created from a .GIF file came out with improper color mapping.

Color or gray-scale to black-and-white conversions are equally chancy. When I converted a 16 gray-scale TIFF image to .PCX, the image came out in reverse; when I tried to invert the image, *HiJaak* stopped dithering, so that my destination image was limited to black and white. No matter what options I tried, it never looked quite right.

INCOMPLETE FACILITIES

HiJaak can't convert color images to shades of gray; to do this, you must use the Make Gray batch file that comes with its extra-cost companion program, *Inset*. You also need *Inset* for viewing and printing the converted images (though you can also print in black and white on Hewlett-Packard printers by converting images to the PCL format, on PostScript printers by converting to .EPS, or on HP plotters by converting to HPGL). *Inset* has a completely different interface, and you must exit *HiJaak* to use it—a terribly inconvenient arrangement.

By the time you read this, Inset Systems should be putting the finishing touches on an upgraded version with a revamped user interface, full 256-color and gray-scale support, and conversions for a number of additional vector file formats. Given the current version's weaknesses, you'd be best off waiting for the new release. ■

HiJaak, Inset Systems Inc., 71 Commerce Dr., Brookfield, CT 06810; (203) 775-5866. **List Price:** $149. **Requires:** IBM PC, XT, AT, PS/2 or compatible, 512K RAM, graphics adapter, DOS 2.0 or later. **In Short:** *HiJaak* handles some esoteric conversions that no other program does, but its age is beginning to show in its klunky user interface and inadequate support for 256-color and gray-scale conversions.

CIRCLE 403 ON READER SERVICE CARD

Robin Raskin *is a contributing editor of* PC Magazine.

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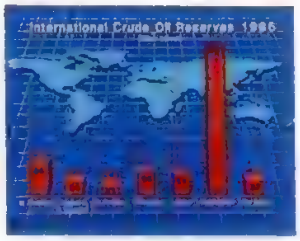

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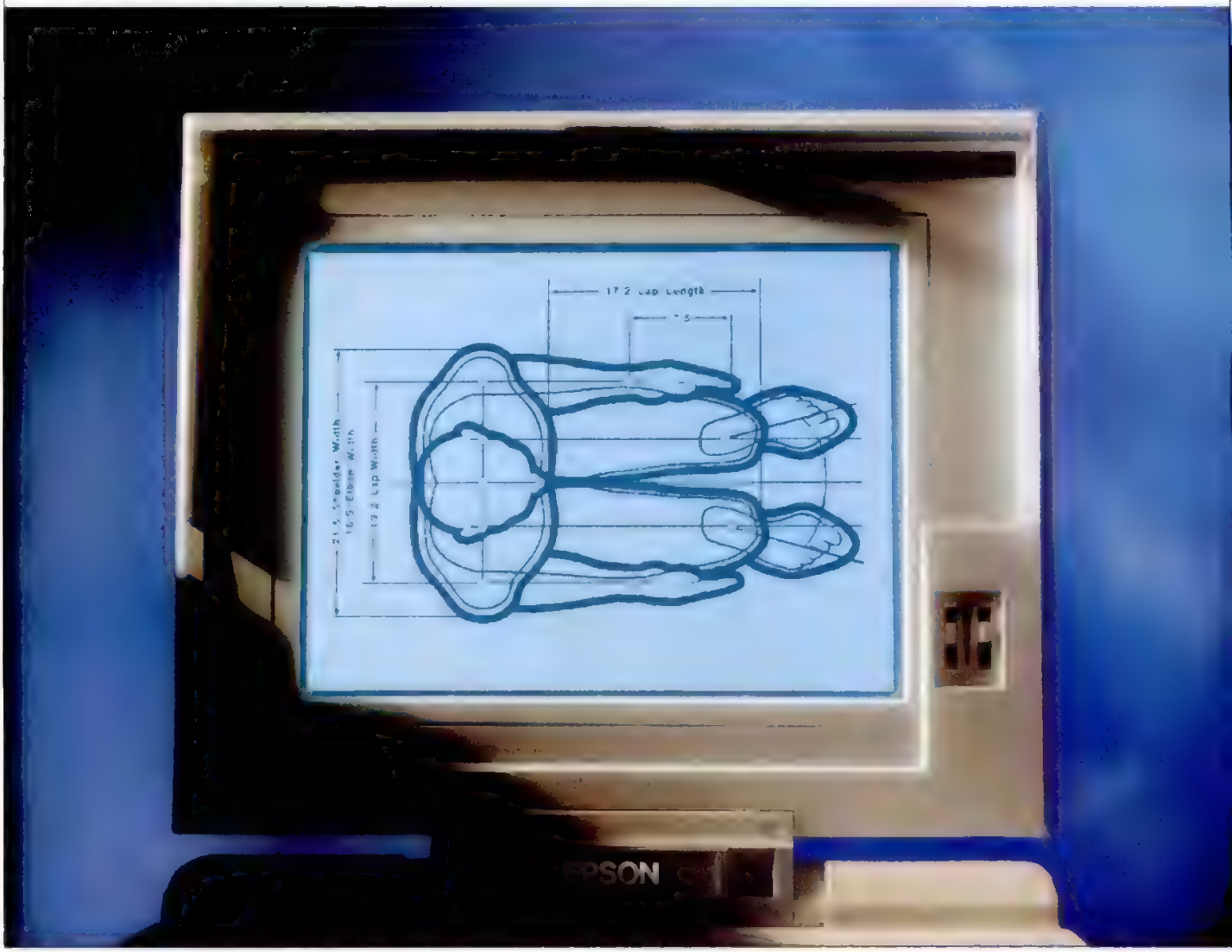

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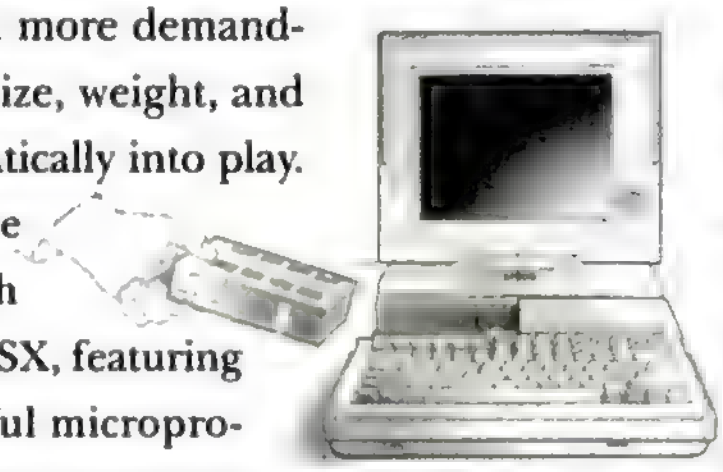

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*IID duplexing feature not supported in PostScript mode.

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CIRCLE 241 ON READER SERVICE CARD

FAX BOARDS DELIVER

Speed, Price, Convenience

While not intended to replace standalone fax machines, fax boards remain the best way to eliminate the logistical delays that continue to plague the standalone. These under-$500 systems offer most of the features you'll ever need.

by Mike Byrd

Even the powerful Caesars couldn't post messages fast enough. That's how far back you can trace the meaning of the word *post:* to messengers' relay stations along the roads built by the Roman Empire. But while today the increased delivery speed of written documents owes a lot to other forms of transportation, recent breakthroughs in electronic transmission—particularly fax technology—have contributed the most.

During the late 1970s, fax machines took only 6 minutes to transmit a page. That was fast then, but it's way too slow these days; modern Group 3 standard fax systems transfer a full page every 10 to 30 seconds. And in the future this speed can only improve.

Despite their fast transmission speeds, however, fax machines inherently retain an element of delay. When sending a document to multiple locations, someone must spend time at the fax machine, hand-feeding the document through the machine once for each intended destination—in other words, a waste of human resources.

ENTER THE FAX BOARD

Fortunately, there's another side of fax technology: internal PC fax boards. These use the power of the PC to automate distribution, eliminate some of the current standalone fax units, and allow fast, unencumbered multiple-location fax transmission.

The PC fax card is not intended to replace the fax machine; it is complementary, allowing increased human resource productivity. It automates many workgroup functions, relieving workers of many manual tasks normally associated with standalone fax machines. And it allows you to effortlessly send documents already stored in the computer.

When your document is already in the computer, a PC fax system makes fax transmission easy. If you're sending a word processing file, for instance, you may first need to convert it to ASCII. You then invoke your fax program to identify where to send the fax, which files to send, and when to send it.

The software takes over, converting the DOS files to the Group 3 fax format and sending them at the time you've specified. Most PC fax systems have a re-dial capability if the called line is busy or if the system encounters an error during transmission. Some also capture the print output from an application program, directing it to a file for subsequent transmission.

> The fax card is not intended to replace the fax machine; it is complementary, allowing increased productivity.

The typical PC fax card comes with software to reformat text and graphics files into fax code and automatically dial destination telephone numbers. Most allow you to send the same fax to multiple receivers. Additionally, many PC fax programs let you schedule calls to take advantage of lower phone rates. All these features sell at much lower cost than many standalone fax machines with comparable capabilities.

PC fax cards have matured since our last review (see "PC to Paper: Fax Grows Up," *PC Magazine*, April 11, 1989). The fax cards we reviewed then had problems, but the past year has seen tremendous changes in both improved function and decreased cost of PC fax cards.

DECIDING YOUR NEEDS

Overall, you've got five faxing options: a standalone fax machine, an internal PC fax card, an external PC fax modem, a third-party fax service, and a LAN fax server. Let's look at the advantages each offers.

Standalone fax. You put a piece of paper in the machine. Its image flashes across the phone lines. Signatures, drawings, marginal notes, and handwritten text go from machine to machine with equal aplomb. Standalone fax machines require little training, work reliably, and aren't intimidating.

Affordable fax machines (selling from $800 to $1,200), however, require a lot of personal attention for anything other than simple page transmission. And unless you have an expensive plain-paper machine (Canon plain-paper models sell, discounted, at about $1,795) at the receiving end, you end up with chalky paper that curls up and loses its image over time.

Fax boards and external fax modems. Cost is the main advantage of both the internal PC fax card and external fax modem (see the sidebar "Fax Modems: The External Connection"). Both offer considerable initial savings over the standalone fax: $200 to $500, versus prices ranging from $639 for a Sharp FO 230 to $1,425 for a Ricoh Fax 65 with similar functions. Many PC fax modems also include a standard 2,400-bit-per-second data modem.

Some internal fax adapters, notably the Intel Connection CoProcessor, can use their 9,600-bps fax modems to exchange files with identical modems on the other end. These modems use V.29 signaling, a CCITT standard for fax modems that is not commonly used for data.

Both types of products allow sending disk-stored files without scanning, which results in a much sharper image at the receiving end. Transmission without scan-

EDITOR'S CHOICE

• **FAX96**

In a field of many worthwhile and competitive products, it's difficult to keep all user needs in mind and come up with one fax board that stands above all the rest in terms of performance and features. Nevertheless, the FAX96 from Fremont Communications Co. remains an easy pick because of the value it provides. Its low price ($195) and long list of features, plus the excellent image quality and fast transmission times we witnessed in our benchmark tests, sold us on this product. Although the FAX96 doesn't contain a data modem, many of us already have data modems and don't need that capability. It also has yet to build in the capability for conversion from Group 3 fax format for editing—at present, you must buy a third-party program such as Inset Systems' *HiJaak*—but most users seek to print, not edit, the received document.

Two products deserve an honorable mention. The first—Intel PCEO's Connection CoProcessor—is also fast and loaded with a number of helpful features. But even its recent price drop to $695, deep street-price discounts, and the included graphics editing software don't bring the price/feature ratio into the range of our top choice.

The second—The Complete Fax, from The Complete PC—lets you pop into fax mode from other applications; its ability to convert from many different file formats is also valuable. You pay a little more for this product both in terms of telephone connection time and its initial sales price of $399, but it's easy to use and delivers excellent quality.

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PC Magazine [July 1989, Page 263]:
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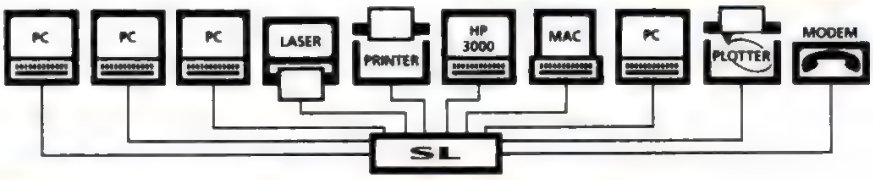

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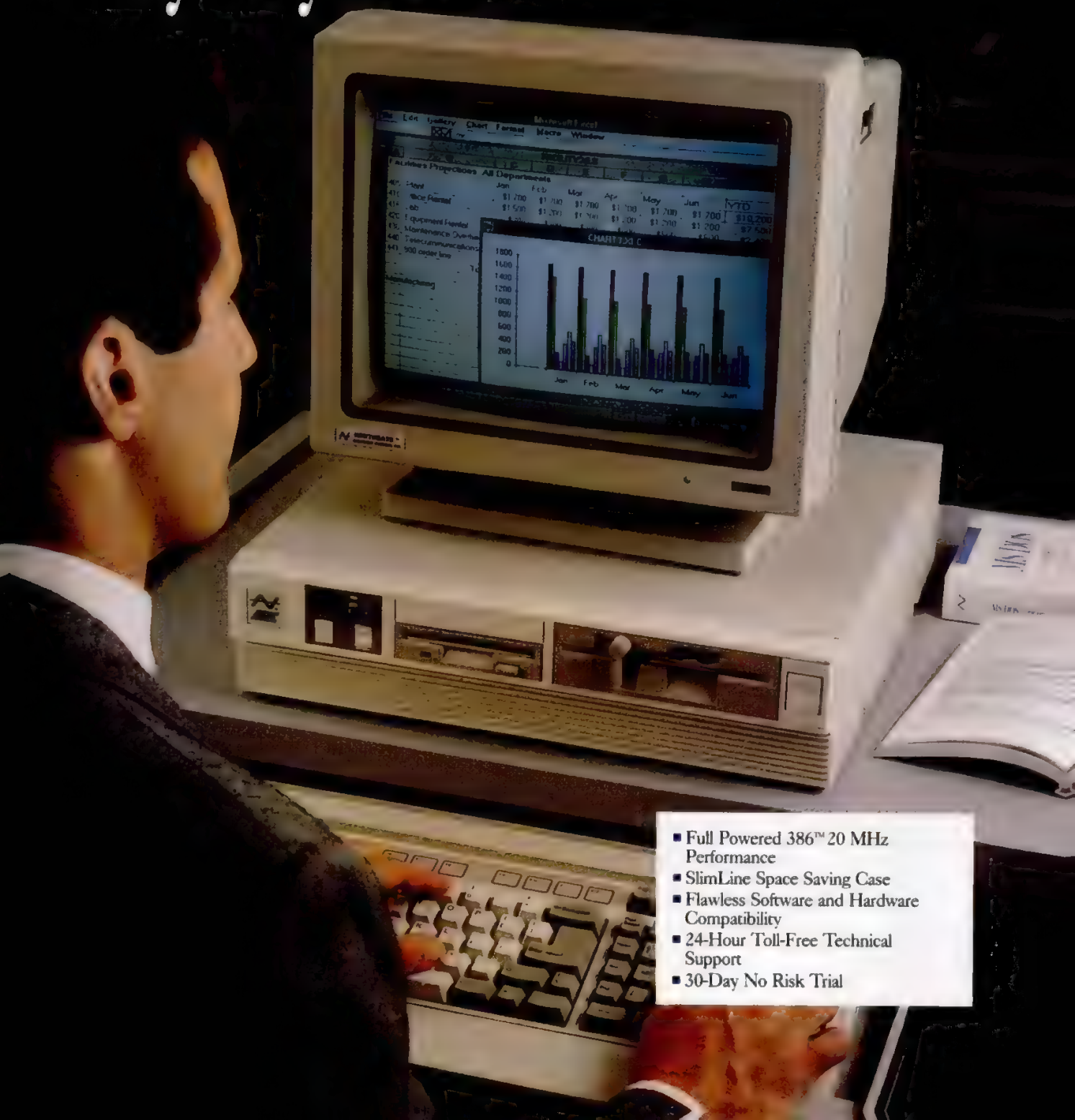

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> *PC Magazine* **said:** *"(SlimLine) doesn't take up a lot of room ... but it delivers plenty of computer for a price you might expect to pay for a 286 system."*

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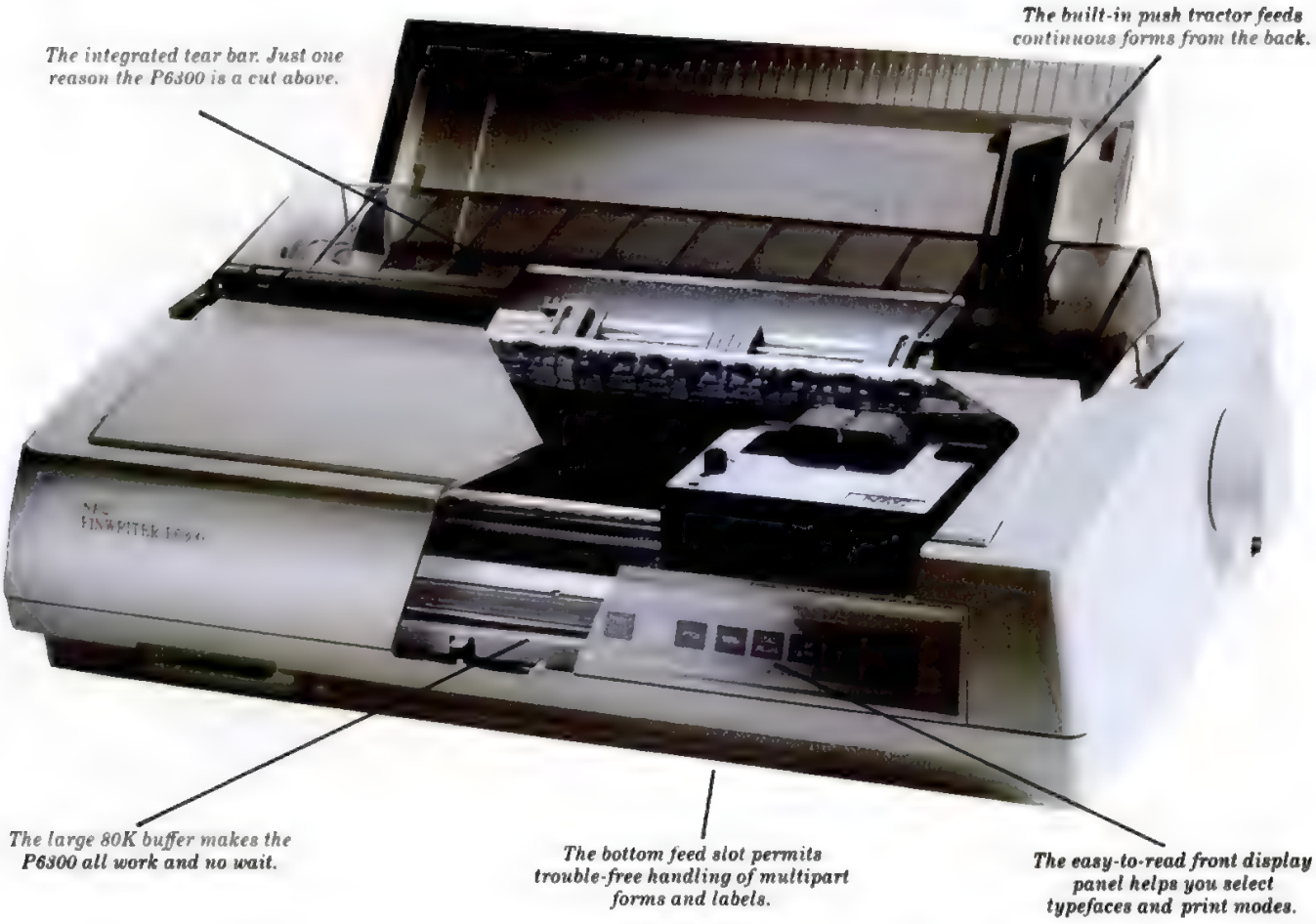
Only the new NEC P6300 has the guts to outperform any dot-matrix printer in its class.



Only the Pinwriter* P6300 printer from NEC has the guts to deliver this much glory:

Bold, black print quality that makes a statement with every line. Color graphics* that turn not only heads, but opinion. Eight standard fonts that let you do more, more impressively. And a Quick Gothic™ font that gives you letter-quality output up to two-thirds faster than anything in its class. But the beauty of the P6300 (and its narrow-carriage brother, the P6200) extends beyond the printed page. Because they give you the ability to print on everything from 24-pound letterhead and envelopes, to continuous forms, labels, and card stock. Plus the ease to go from one to another, from one minute to the next.

It takes guts to say the Pinwriter P6300 is the best dot-matrix printer you can buy today.

It takes a lot less than you think to bask in its glory.

*Color kit sold separately.

NEC

NEC Technologies, Inc. 1414 Massachusetts Ave., Boxborough, MA 01719. 1-800-NEC-INFO. In Canada, 1-800-343-4418.
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C&C

ning eliminates many of the undesired dots and lines on the received page. Most PC fax programs, including all those reviewed here, convert files to the fax Group 3 format before dialing the receiving number. Therefore, your telephone connect time may be significantly shorter—a real cost savings.

You discover the major drawback to PC fax cards and external fax modems, however, when you want to send a hardcopy document that's not on disk. This situation requires scanning the document into a data file. Using a scanner to get the image into the computer is expensive (about $1,100 for the HP ScanJet Plus) if it only supports the fax card (see "From Fax to Finish: Scanners Build a Better Image," *PC Magazine*, March 28, 1989).

Third-party services. If you use electronic services such as MCI Mail or AT&T Mail, you probably already know that these services can send your messages to a mix of e-mail addressees and fax machines. The advantages are many: you need not post a staffer at the fax machine during the time it takes to fax a document to multiple parties—or even to one party whose line is continually busy. You also can register such graphics as your company logo, a letterhead, or signatures for on-the-fly attachments to letters. These services are convenient, although by and large they're most useful for sending ASCII text. And there's no way to receive incoming fax messages.

PC LAN fax servers. These systems, which share the resources of a single PC equipped with a fax board across a LAN, offer the operational advantages of an internal fax card to everyone on the network. They also allow access to more users with fewer dedicated telephone lines. This is less of a blessing than it might seem. Most PC LAN fax servers require a dedicated PC acting as a fax server, routing both incoming and outgoing faxes.

Handling outgoing faxes through a fax server presents few problems; however, incoming faxes need distribution of some sort. Printing and manual distribution is easy, but a less obvious step is electronic distribution of the received faxes on a network. Currently, this is a manual task. Someone must read the electronic images of the received faxes and send them across the network to the correct recipient.

CONNECT-TIME FACTORS

When you send a fax, there are several time-consuming steps involved. You must wait for access to the device, which may or may not be a problem. It takes time to feed in or stack the document—a problem that won't go away as long as you use a standard machine.

If you use a fax-equipped PC, the access problem mercifully goes away. So do the paper-feeding hassles: fax boards make the document-handling process automatic, or at least as simple as a menu selection. Offsetting these advantages, however, is the connection time billed by the telephone company. Don't look for savings here. You won't find any.

A standard fax machine makes the telephone connection before it reads the documents for transmission. Then it scans each document a line (0.01 inches high) at a time, converts the image to Group 3 format, transmits the pattern, and waits for the receiving fax machine to acknowledge transmission. Mistakes in connection, inadequate paper supply, and any number of human errors often negate full transmission, requiring a repeat of the entire process until good images cross the wire.

> Choosing an internal fax board with a long connect time can very well result in higher than necessary telephone bills.

Unfortunately, PC fax boards have a lot of overhead, too. Program and image files have to flow from a disk drive through the PC while its data bus handles a stream of modem-generated interrupts. In our tests, the fastest PC fax boards had to connect for about 93 seconds to send a 120K image to either a standalone fax machine or to another fax board; the slowest boards had connection times of up to 198 seconds. The standalone fax machine had the same connection time as the fastest boards when it scanned the test image from paper to send to another standalone fax machine or fax board.

Again, you don't save telephone connection time when you use PC fax boards. Choosing an internal board with a long connect time, in fact, can result in higher than necessary long-distance telephone bills. What is probably faster, though, is the overall fax transmission process. It takes place at your desk, and there is little interruption in the flow of work. *Those* savings are hard to ignore.

GROUP 3 FORMAT WOES

Sending faxes though either a fax machine or a PC fax board is simpler than ever. Receiving documents on your office's fax machine is also a easy operation. But what about the Group 3–formatted files you receive on your PC via an internal fax board or external fax modem? It gets trickier at this point.

A receiving PC stores incoming faxes as files on a disk. You can view the incoming fax on your monitor, but since screen size is less than that of an 8.5- by 11-inch fax page, a full page on the screen is difficult or impossible to read. The letters of text break up on the screen (fewer dots per inch), and you must zoom in to small areas to read typewritten text.

Nevertheless, you can usually get enough understanding of the message in the received image to decide if you want to print it for easier reading using a standard dot-matrix or laser printer. This allows you to display which faxes you want to print.

Printing, you'll find, is slower than that for most fax machines (4 to 5 minutes per page on an Epson MX-100), but the print and paper quality outweigh the time differential. Fax files use a lot of space on your hard disk—about 100K or more for a two-page document—so it doesn't pay to leave them there for long.

If you're interested in editing the received fax document, keep in mind that you can't edit a received fax image using the spreadsheet or word processor that someone else used to create the information. The file you receive is a graphics file formed by thousands of white and black dots arranged according to the Group 3 fax format. Our eyes recognize the letters and pictures out of those dots, but your word processor or spreadsheet will not. Your fax program may or may not allow you to convert the fax file to one of the typical graphics file formats (.IMG, .MAC, .PCX, .PIX, or .TIF).

If you really need to convert graphics files to text, you'll need an optical character reader (OCR) program. These are expensive and, while OCR technology has

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improved dramatically over the past few years, they remain less than perfect. Currently the best OCR programs, like Calera's *TrueScan* and Caere's *OmniPage*, have a 98 percent success rate in recognizing and converting dots to letters. Even with this optimum rate, you will still have an error in one out of every ten words.

Moreover, if the inbound fax has many extraneous black dots or if the original document was photocopied at a slight angle, the character recognition success rate falls dramatically. OCR programs are not only sporadically inaccurate but are also very slow.

OUR EVALUATION

For this review we chose to consider PC fax cards with a suggested retail price of less than $500. Above this price level, internal fax boards are less competitive with modern standalone fax machines.

The only exception we found was Intel's Connection CoProcessor, which lists for $695. We included the Connection CoProcessor for two reasons: (1) it was an Editor's Choice in last year's review and has since become an industry standard, and (2) Intel recently reduced the price 40 percent, enabling buyers to find it discounted to about $500.

PC fax cards fall into two classes: those that send and receive in the background, and those that are coresident in RAM and stop the current application while receiving or transmitting faxes. Background operation fax systems include Brooktrout Technology's Fax-Mail 96, Calculus's EZ-Fax48 and 96, Intel's Connection CoProcessor, The Complete PC's The Complete FAX, Choice Technology Group's DeskFax Professional, Computer Friends' Lightfax 9624BH, Macronix's MaxFax 9624, and American Data Technology's SmartFax. Coresident systems include Cardinal Technologies' SendFax Modem 4800, Everex Systems' EverFax 24/96, Freemont Communications' FAX96, Hayes Microcomputer Products' Hayes JT Fax 4800B, The Fax Group's FaxPro I, and GammaLink's GammaFax NA. True background operation is better, but if you send and receive faxes from your computer only, the price differential in the coresident systems merits their consideration.

Over-$500 fax boards are less competitive with standalone fax machines.

The competition is fierce; the 18 products we reviewed represent a wide range of designs, but functionally all have the same transmission features. Two products—Cardinal's SendFax Modem 4800 and Prometheus Products' ProModem 2400BFAX—only transmit and don't have provisions for receiving. All are Group 3 standard faxes, and all maintain a log of inbound and outgoing transactions. Most have a broadcast (same document, multiple receivers) capability with some sort of file chaining or merging.

Normally, background operation results in quicker transmission times, but this was not true in all cases here. Some RAM coresident packages stop foreground applications while a fax is being transmitted or received. This is not a serious penalty at 9,600 bits per seconds, but the inherent slowdown of the foreground application may justify a stop for a cup of coffee while the inbound fax is received and filed.

So what is the right choice for you? It depends on your specific requirements, for all types have their place. A small business or office can probably get by with either a standalone fax machine or a PC fax card. If you work mostly with a computer and primarily need to send computer files, then the PC fax card may fit your needs.

What about a business requiring duplication of existing printed documentation? The standalone fax machine serves best here. Larger businesses and offices may require a combination of a standalone fax machine and PC fax cards, or even a PC LAN file server.

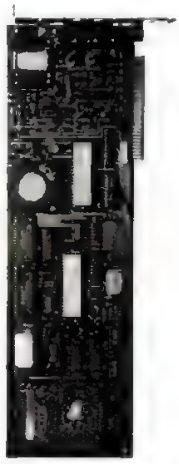
With growth running unabated, the PC fax card is just reaching maturity, offering tremendous potential for integrating the concept with other PC applications. On the horizon is implementation of the Group 4 standard, which allows faster transmission at higher resolutions, but the investment in facilities that Group 4 would require won't take place overnight. Also, proposed enhancements to the Group 3 protocols offer stiff competition to any switch to Group 4.

So don't go out and sell your current fax machine; Group 3 should be around for a long time.

AMERICAN DATA TECHNOLOGY INC.

SmartFax
SmartFax 48

by Kimberly Maxwell



A smart shopper will check out American Data Technology's two economical internal fax boards. Except for their transmission speed, they are almost identical in features: the $399 SmartFax transmits at 9,600 bits per second; the $299 SmartFax 48, at 4,800 bps.

The SmartFax packages include the software necessary for sending and receiving faxes, along with good documentation and hardware that fits into any 8- or 16-bit AT-bus slot. The adapter card has an on-board processor and memory, which let you transmit and receive documents in the background without exiting your current activity.

Documents can be stored in fine or normal resolution. Normal mode is 200 dots per inch horizontally by 100 dpi vertically;

FACT FILE

American Data Technology Inc., 44 W. Bellevue Dr., #6, Pasadena, CA 91105; (818) 578-1339.
SmartFax
List Price: $499
Requires: 640K RAM; hard disk; CGA, EGA, or Hercules monochrome monitor; DOS 2.0 or later.

CIRCLE 637 ON READER SERVICE CARD

SmartFax 48
List Price: $299
Requires: 640K RAM; hard disk; CGA, EGA, or Hercules monochrome monitor; DOS 2.0 or later.
In Short: The SmartFax and SmartFax 48 are identical in features, except for the transmission speed and price. Depending on which you want, you can select either of these American Data Technology products with confidence. Both send clear faxes and automatically convert some of the standard file formats into fax format.

CIRCLE 638 ON READER SERVICE CARD

fine mode is 200 by 200 dpi. Since the software can transmit in either mode, the resolution of the document is what determines the mode in which it is sent.

MENU-DRIVEN INTERFACE

We found the SmartFax software's menu-driven interface and the on-line help windows useful. From the main menu you can transmit, receive, edit, scan, and print faxes. Sending faxes is simple: you invoke the transmission menu, enter the filename and fax number, and transmit your fax.

You can use the DOS command line to send a fax, too: at the DOS prompt, just type SF with the filename and the fax number. In addition, a DOS function utility on your main menu lets you perform DOS functions without exiting SmartFax. Included are such functions as rename, erase, copy, type, change or list directory, and select drive.

A programmer's interface allows you to integrate SmartFax into your communications software. When you use this interface, you can drive the SmartFax software either at the DOS command level or at the interrupt level.

Within the SmartFax software, a conversion program automatically translates text and graphics into fax format. The conversions take place so quickly that you may miss it if you blink.

Translation takes place automatically or manually before, during, or after transmission. You can convert fax format to and from other formats, convert a normal-resolution fax to and from high resolution, and convert received, spooled messages to DOS files for further processing. Additionally, you can convert faxes from ASCII, *WordStar*, .PCX, *Dr. Halo*'s .CUT format, and others through Epson FX-80 print capture, which takes place within the conversion menu in the software.

A nifty screen capture facility allows you to capture a graphic image on the screen and send it directly as a fax. With the system's print capture program, you can send files from any application that supports Epson FX-80 printers.

Because the print capture program is a TSR, you can't load it along with a large DTP program such as *Ventura Desktop Publisher*. The utility SFPRINT, however, works with the print capture program to let you print *Ventura* print files to an I/O port. From here, the print capture program captures the data and automatically converts the files into fax format.

If you have a scanner available, you can fax directly from the scanner as if you were using an ordinary fax machine. While SmartFax does not have a scanner interface, its software has the necessary drivers for attaching a compatible scanner. A hot-key lets you toggle between sending from the scanner and selecting an option from the main SmartFax menu.

You can also print from the same window on the main menu. The Smartfax boards are compatible with the Canon Laser Printer, Epson FX and LQ, IBM Graphics, HP LaserJet, and other printers.

Under the main menu, an editor program lets you manipulate and modify your faxes. Some of the routines you will find include rotate, cut and paste, text and block edit, zoom, and scroll. You can also modify your fax images with *Dr. Halo*, *HP Scanning Gallery*, and *PC Paintbrush*.

HELPFUL FEATURES

Several features help make your fax transmission a speedy process. A phone directory lets you store fax numbers and use their abbreviations for speed dialing. The facilities menu gives you area codes, country codes, world times, and time zones—a convenience not found in many fax products we tested.

A transmission scheduler allows you to send a fax at designated times to save money on long-distance numbers during off hours. A log keeps track of all incoming and outgoing faxes, so you can monitor the number of fax calls. You can also send multiple files or pages, either manually or automatically.

Although we installed these products without a hitch, their testing did not go smoothly. The SmartFax 48's interpretation of a fax sent by our Murata Group 3 machine put a clear image on the screen. But the printed version from our HP LaserJet printer did not have the same clear image, and the quality was lower compared with that of the other fax products.

Though we were disappointed with the results of our printing tests, we found these products to have unique features. A clear fax image on the screen, a full-featured graphics editor, and a simple menu-driven software package make the SmartFax products a good choice over many others.

OUR CONTRIBUTORS

Dennis Boatner is a computer consultant working in northwest Florida.
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BROOKTROUT TECHNOLOGY INC.

Fax-Mail 96

by C. G. Milligan

Brooktrout Technology's $499 Fax-Mail 96 system is the little brother in a family of fax systems. It's a product that reveals attention to detail in every aspect of its design. From its menu system to background operation and command line utilities, this package has features to please everyone alike, from novices to power users.

Fax-Mail's user guide and installation

FACT FILE

Fax-Mail 96
Brooktrout Technology Inc., 110 Cedar St., Wellesley Hills, MA 02181; (617) 235-3026.
List Price: $499
Requires: 256K RAM, DOS 2.0 or later.
In Short: This FCC Class B approved, 9,600-bps fax system provides excellent copy resolution, powerful command line utilities, and a menu interface with optional TSR capability. Conversion speed is not the fastest we tested, but overall this is one quality product.

CIRCLE 639 ON READER SERVICE CARD

FAX BOARDS: SUMMARY OF FEATURES

	Fremont Communications Co. **FAX96**	Calculus Inc. **EZ-Fax48**	Prometheus Products Inc. **ProModem 2400BFAX**	Cardinal Technologies Inc. **SendFax Modem 4800**	Hayes Microcomputer Products Inc. **Hayes JT Fax 4800B**	American Data Technology Inc. **SmartFax 48**	Calculus Inc. **EZ-Fax96**	American Data Technology Inc. **SmartFax**
List price	$195	$199	$199	$249	$295	$299	$299	$499
FAX FEATURES								
Standard Group 3 speeds (bps)	9,600, 7,200, 4,800, 2,400	4,800, 2,400	4,800	4,800	4,800, 2,400	4,800	9,600, 7,200, 4,800, 2,400	9,600
High-resolution mode	■	■	■	❑	■	■	■	■
Gray scale or dithering	❑	■	■	■	■	■	■	■
Transmits compressed fonts	❑	■	❑	■	■	■	■	■
Maximum number of pages transmitted	Unlimited	Unlimited	128	Unlimited	Unlimited	999	Unlimited	999
Polls	❑	❑	■	■	❑	❑	❑	❑
Runs in background mode (RAM)	■	■	■	❑	❑	■	■	■
RAM used	65K	60K	40K	N/A*	N/A*	60K	60K	60K
Chip set used	Yamaha	Rockwell	Sierra	Sierra	Rockwell	Rockwell	Rockwell	Rockwell
TRANSMISSION								
Accepts batch command-line inputs	❑	■	❑	❑	■	■	■	■
Transmits directly from scanner	■	■	❑	❑	■	■	■	■
Sends current screen in response to PrtSc	❑	■	❑	❑	■	❑	■	❑
Saves current screen to file	❑	■	❑	❑	■	■	■	■
Directs printer text output to fax	❑	■	❑	■	■	❑	■	❑
Directs printer graphics output to fax	❑	■	❑	❑	❑	❑	■	❑
Saves printer text output to file	❑	■	❑	❑	■	■	■	■
Saves printer graphics output to file	❑	■	❑	❑	■	■	■	■
Converts to fax format from:								
ASCII	■	■	N/A†	N/A†	■	■	■	■
.CUT (*Dr. Halo*)	❑	■	N/A†	N/A†	❑	■	■	■
.DCX (*PC Paintbrush*)	❑	❑	N/A†	N/A†	❑	❑	❑	❑
Epson FX printer output	❑	❑	N/A†	N/A†	❑	■	❑	■
.IMG (*GEM Paint*)	❑	❑	N/A†	N/A†	❑	❑	❑	❑
.MSP (*Microsoft Paint*)	❑	❑	N/A†	N/A†	❑	❑	❑	❑
.PCX (*PC Paintbrush*)	■	■	N/A†	N/A†	■	■	■	■
.PIC (*Lotus 1-2-3*)	❑	❑	N/A†	N/A†	❑	❑	❑	❑
.TIF (Tagged Image File Format)	■	❑	N/A†	N/A†	❑	■	❑	■
WordStar	❑	❑	N/A†	N/A†	❑	■	❑	❑
Converts fax format to:								
.CUT (*Dr. Halo*)	N/A**	■	❑	❑	❑	■	■	■
.DCX (*PC Paintbrush*)	N/A**	❑	❑	■	❑	❑	❑	❑

PC—Editor's Choice ■—Yes ❑—No
*N/A—Not applicable: the product does not have this feature.
†N/A—Not applicable: the product transmits but does not receive faxes.
**N/A—Not applicable: FAX96 needs third-party software to convert from fax format.

manuals are well-written, which makes installing and learning the system a breeze. The menu-driven configuration is also very simple. And for power users, Brooktrout provides all necessary information for manual installation.

The ¾-length interface card uses jumpers and DIP switches for its system interrupt and port address. You'll find the default settings fine for most systems, but modification may be required in a fully loaded system.

The installation manual covers hardware settings in depth, and Brooktrout offers free technical support for its products; however, the phone call is not toll-free.

USER INTERFACE

The Fax-Mail user interface features a pull-down menu system that gives a user total control over all send and receive operations. An assortment of status screens provides the user with access to fax queues, transmission scheduling, and transmission logs of faxes received or sent, as well as current call status.

Error handling is exceptional, and Fax-Mail logs conditions of success, error, or failure of a transmission, such as how many pages were sent before the phone company hiccupped. The system also has an intelligent fax rescheduling system that will attempt to retransmit the bad pages or the entire fax job if required. The log automatically purges files 30 days old if you desire, helping to keep your hard disk clear of old jobs.

Brooktrout takes a slightly different approach to compatibility issues. Rather than directly supporting an ever-increasing list of hardware and software products on the market, Brooktrout has concentrated its efforts on delivering functionality in the popular standards. This eliminates wide gaps in compatibility as new products are introduced.

The Complete PC The Complete FAX	Everex Systems Inc. EverFax 24/96	The Fax Group FaxPro I	ESCO Systems Technology SkyFAX	Choice Technology Group Ltd. DeskFx Professional	GammaLink GammaFax NA	Brooktrout Technology Inc. Fax-Mail 96	Computer Friends Inc. Lightfax 9624BH	Macronix Inc. MaxFax 9624	Intel PCEO Connection CoProcessor
$399	$399	$399	$399	$429	$495	$499	$449	$499	$695
4,800, 2,400	9,600, 7,200, 4,800, 2,400	9,600, 4,800, 2,400, 1,200	9,600, 7,200, 4,800, 2,400	9,600, 7,200, 4,800, 2,400	9,600, 7,200, 4,800, 2,400	9,600	9,600, 7,200, 4,800, 2,400	9,600, 7,200, 4,800, 2,400	9,600
■	❑	■	■	■	■	■	■	■	■
■	❑	■	■	❑	■	■	■	❑	■
■	❑	■	■	■	■	■	■	❑	■
999	Unlimited	99	Unlimited	Unlimited	Unlimited	2,880	Unlimited	Unlimited	Unlimited
■	■	■	❑	❑	■	■	■	❑	■
■	■	❑	■	■	■	■	■	■	■
58K	95K	N/A*	58K	179K	180K	60K	64K	103K	63K (with EMS, 5.5K)
Rockwell	Rockwell	Yamaha	Rockwell	Yamaha	Rockwell	Rockwell	Rockwell	Yamaha	Rockwell
■	❑	■	■	■	■	■	❑	❑	■
■ (with The Complete PC scanners only)	■	■	■	❑	❑	❑	■	■ (with UMAX only)	❑
■	❑	❑	❑	■	❑	■	❑	❑	❑
❑	❑	■	❑	■	❑	■	❑	■	■
❑	❑	■	■	■	■	■	■	■	■
❑	❑	■	■	■	■	■	■	■	■
❑	❑	❑	■	■	❑	■	■	■	❑
❑	❑	❑	■	■	❑	■	■	■	❑
■	■	■	■	■	■	■	■	■	■
■	❑	❑	❑	❑	■	❑	❑	❑	❑
❑	❑	❑	❑	❑	❑	❑	❑	❑	■
■	❑	❑	■	❑	❑	■	❑	❑	❑
■	■	■	❑	❑	❑	❑	■	❑	❑
■	❑	❑	❑	❑	❑	❑	■	❑	❑
■	■	❑	❑	■	■	■	■	■	■
❑	❑	❑	❑	❑	❑	❑	■	❑	❑
❑	■	■	❑	■	■	❑	■	❑	❑
❑	❑	❑	■	❑	❑	❑	❑	❑	❑
■	❑	❑	■	❑	■	❑	❑	❑	❑
❑	❑	❑	❑	❑	❑	❑	❑	❑	■

CONTINUES

Fax-Mail directly supports IBM and Epson printers in addition to HP LaserJet models. It also provides driver support for Canon, HP ScanJet, and Brooktrout IX-12 scanners.

Fax-Mail's printer capture utility, PRTCAP, allows the user to simply "print" a spreadsheet, CAD drawing, or graphics image directly from the application.

The program captures the file, automatically converting it to fax format, and transmits as desired. A hotkey turns PRTCAP on and off to keep it from capturing normal print jobs. As practically all software packages support IBM, Epson, or Hewlett-Packard printer standards, compatibility is ensured.

Fax-Mail's error handling system is exceptional, and the software logs each transmission's success, error, or failure.

TYPICAL FEATURES

Naturally, Fax-Mail has all the typical features we've come to expect from a package like this, such as attaching letterheads and signature files, identification strings, and time-date stamps. Distribution phone lists are a must if you have a fax to send to multiple clients.

The polling option has a handy turnaround feature to allow the other fax machine to transmit its fax after receiving yours. In addition, there's a text editor that uses *WordStar*-like key commands and a Supershow utility to view and edit fax images before printing.

Fax-Mail converts to fax format any file saved in standard ASCII text, *PC Paintbrush*'s .PCX format, or any file from an

FAX BOARDS: SUMMARY OF FEATURES

	Fremont Communications Co. FAX96	Calculus Inc. EZ-Fax48	Prometheus Products Inc. ProModem 2400BFAX	Cardinal Technologies Inc. SendFax Modem 4800	Hayes Microcomputer Products Inc. Hayes JT Fax 4800B	American Data Technology Inc. SmartFax 48	Calculus Inc. EZ-Fax96	American Data Technology Inc. SmartFax
Converts fax format to:								
.IMG (*GEM Paint*)	N/A**	❑	■	■	❑	❑	❑	❑
.MSP (*Microsoft Paint*)	N/A**	❑	❑	❑	❑	❑	❑	❑
.PCX (*PC Paintbrush*)	N/A**	■	■	■	■	■	■	■
.SSC (SkySCAN Image Format)	N/A**	❑	❑	❑	❑	❑	❑	❑
.TIF (Tagged Image File Format)	N/A**	❑	■	■	❑	■	❑	■
Translates files automatically prior to transmission	■	■	■	❑	❑	■	■	■
Translates files automatically during transmission	❑	■	❑	■	■	❑	■	❑
Erases automatically after transmission	■	■	■	■	■	■	■	■
OPERATION								
Compatible scanners:								
Canon Image Scanner	■	■	❑	❑	■	■	■	■
DEST PC Scan	■	■	❑	❑	❑	❑	■	❑
HP ScanJet	■	❑	❑	❑	■	■	❑	■
Microtek	■	❑	❑	❑	❑	❑	❑	❑
Panasonic	■	❑	❑	❑	❑	❑	❑	❑
Princeton Graphic Systems	■	■	❑	❑	■	❑	■	❑
Other	Chinon; any model that creates .PCX or .TIF file	Logitech ScanMan	None	None	Brother, Chinon	Pentax SB-A4301	Logitech ScanMan	Pentax SB-A4301
Generates letterhead	❑	❑	❑	■	■	■	❑	■
Generates automatic cover page	■	❑	■	■	■	■	❑	■
Graphics editor	❑	❑	❑	❑	■	■	❑	■
Can merge fax files	■	■	■	■	■	■	■	■
Can chain files for transmission	■	❑	■	■	■	■	❑	■
Text editor	❑	❑	■	■	❑	❑	❑	❑
Generates custom fonts	❑	■	❑	■	❑	❑	■	❑
Includes standard modem	❑	❑	■	■	❑	❑	❑	❑
Voice/fax auto-detect	Optional ($50)	❑	❑	❑	❑	❑	❑	❑
FCC certification class	B	B	B	B	B	A	B	A
Toll-free number for customer support	❑	❑	❑	■	❑	❑	❑	❑
Extended service contract	■	■	❑	❑	■	■	■	■

—Editor's Choice ■—Yes ❑—No
**N/A—Not applicable: FAX96 needs third-party software to convert from fax format.

application supporting IBM, Epson, or HP LaserJet printers. File conversion is automatic, but manual conversion is also available if you don't wish to have it done on the fly. Fax-Mail also converts fax files to .PCX format.

Practically any portion of the menu system can run from a command line mode. The command line utilities are perhaps the most powerful aspects of this package, each having many optional parameters for total control.

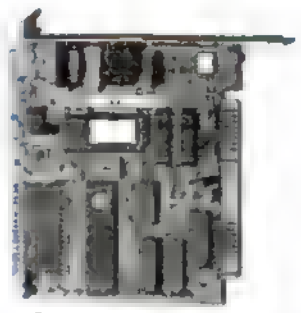
This arrangement speeds things up for the power user, since batch files can control most of the operations. All TSR utilities are removable as required to conserve memory, and at a memory cost of only 47K, it won't add much overhead to an already loaded system.

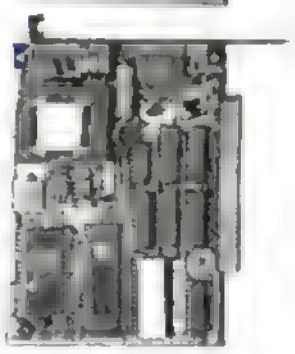
Conversion speed is not the fastest we tested, but the image quality is nothing short of excellent. If you need a dependable 9,600-bit-per-second fax system with functionality, great support, and easy operation, this unit will serve nicely. Brooktrout's Fax-Mail system is a quality product at a fairly reasonable price, and that's no fish story.

CALCULUS INC.

EZ-Fax48
EZ-Fax96

by Kimberly Maxwell





Calculus is a branch of upper-level mathematics, but Calculus's EZ-Fax48 and EZ-Fax96 are two simple internal fax adapter cards with lower-level pricing. These inexpensive products offer nice installation features and provide high-quality fax capabilities for your PC.

PC LAN Labs tested two Calculus fax

The Complete PC **The Complete FAX**	Everex Systems Inc. **EverFax 24/96**	The Fax Group **FaxPro I**	ESCO Systems Inc. **SkyFAX**	Choice Technology Group Ltd. **DeskFax Professional**	GammaLink **GammaFax NA**	Brooktrout Technology Inc. **Fax-Mail 96**	Computer Friends Inc. **Lightfax 9624BH**	Macronix Inc. **MaxFax 9624**	Intel PCEO **Connection CoProcessor**
❑	■	■	■	❑	❑	❑	■	❑	❑
■	❑	❑	■	❑	❑	❑	■	❑	❑
■	■	■	■	■	■	■	■	■	■
❑	❑	❑	■	❑	❑	❑	❑	❑	❑
■	■	■	■	■	■	❑	■	❑	❑
■	■	■	■	❑	■	■	■	■	■
❑	❑	❑	❑	■	❑	❑	❑	❑	■
■	❑ (erases when reloaded into RAM)	■	■	❑	❑	❑	❑	❑	❑
■	■	■	■	❑	■	■	■	❑	■
■	❑	❑	❑	❑	■	❑	❑	❑	❑
■	■	■	■	■	■	■	■	■	■
■	❑	❑	❑	❑	❑	❑	❑	❑	❑
❑	❑	■	❑	❑	❑	❑	❑	❑	❑
Any Complete PC scanners	Abaton, Ricoh	IBM, Ricoh	Skyscan hand scanner	None	CompuScan, Logitech	None	Lightspeed Handy Scanner	Any model that creates .PCX file	None
❑	■	■	■	■	■	■	❑	■	■
■	■	■	❑	■	❑	❑	■	■	■
❑	❑	❑	■	❑	❑	■	■	❑	■
■	■	■	■	■	■	❑	■	■	■
■	■	■	■	■	■	❑	■	■	■
■	❑	■	■	❑	❑	■	■	❑	■
❑	■	■	■	■	■	■	❑	❑	■
❑	■	Optional ($199)	❑	❑	❑	❑	■	■	Optional ($195)
❑	❑	❑	❑	■	❑	❑	❑	❑	❑
B	B	B	B	B	B	B	B	B	B
❑	❑	■	❑	■	❑	❑	❑	■	■
❑	■	■	❑	■	■	❑	■	■	■

ENDS

products. Each package has identical software, but the hardware transmission speeds and costs vary. The 4,800-bit-per-second EZ-Fax48 sells for $199 before street-price discounting; the EZ-Fax96 (9,600 bps), for $299.

The basic hardware board used in both of Calculus's fax products is unique in that it has two on-board processors that support multitasking: a 12-MHz Intel microprocessor and a Calculus-designed coprocessor.

The dual processors, along with a 160K background communications manager program, give the products the ability to do real background-mode transmission without disrupting foreground tasks in the meantime.

INSTALLING THE SYSTEM

Unlike many other products that have two phone ports—so that you can plug in a telephone and the phone line—the EZ-Fax adapters have only one RJ-11 phone port. The one port could cause a problem if you have only one phone line and still need a telephone for normal use, but a simple solution is to buy an inexpensive two-jack phone adapter.

A nifty program called SFMODEM synchronizes your telephone line so that you can use the EZ-Fax with any external or internal data modem or a telephone. This modem-control utility activates and deactivates the fax process and coordinates your fax with data-modem communications. It proves its worth when you are sharing a telephone line between the fax and the data modem.

Another advantage is that you can also use this program to unload the background communications manager from memory to increase your available memory for other application programs.

But while the EZ-Fax software is in RAM, there are several ways you can configure it so that it uses less memory. You can load its File Manager Menu system without the ability to display fax images on the screen, for example, and it will take 160K RAM. If you wish to use the menu system with the display fax capability, it will cost you an additional 90K.

You won't find any DIP switches on the EZ-Fax card. The software's install pro-

gram automatically selects the card address and interrupts from unused locations and detects your monitor type. This is an outstanding feature, but it doesn't guarantee freedom from conflicts when you install the next mouse, LAN, or other expansion card.

FILE CONVERSION

EZ-Fax software can convert text and graphics into fax format. It does not convert during transmission, but you can convert ASCII, .PCX, .CUT, and other formats into fax format through the menu system.

EZ-Fax's application interface, in fact, allows you to convert any file that can be printed on an Epson FX printer. You also may send a document directly from your application using the application's print function. But this file must be in ASCII format; the application must be set up to print to the EZ-Fax device listed on the Install menu; and the background communications manager must be loaded. These conditions soon become second nature.

The software contains drivers for a wide range of printers, including the Epson FX and LQ24, HP LaserJet, Okidata Microline 292, IBM Graphics, Toshiba P351, and other models.

If you're interested in scanning images to send by fax, for $299 more Calculus bundles a 400-dot-per-inch handheld scanner called EZ-FaxScan with the EZ-Fax48. If you already have a compatible scanner, EZ-Fax software has scanner drivers for the Canon IX-12, Princeton Graphics' LS-300, Logitech's ScanMan, and several DEST models.

FACT FILE

Calculus Inc., 522 Mercury Dr., Sunnyvale, CA 94086-4018; (408) 733-7800.
EZ-Fax48
List Price: $199
Requires: 512K RAM, hard disk, DOS 2.0 or later.

CIRCLE 640 ON READER SERVICE CARD

EZ-Fax96
List Price: $299
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: Calculus has low-cost solutions for anyone seeking an internal fax card. Both the 4,800-bps and 9,600-bps products feature easy installation, and the software works with many file formats.

CIRCLE 641 ON READER SERVICE CARD

OTHER FEATURES

EZ-Fax has a phone directory for frequently called numbers; you simply enter the number into the phone book and assign the number with an ID. When you wish to call up a number to send a fax, you enter the ID. You can also combine fax tags with the mail-merge capabilities of your word processor.

You can schedule fax broadcasts during off-hours, which helps if you need to send a great number of faxes. If you want to see a record of your fax activity during any time of the day or night, the EZ-Fax software keeps an activity journal menu where you can view all transactions including received, transmitted, converted, scanned, and printed faxes. Calculus has a BBS so that you can download updates or find out product information.

If you're looking for an internal fax board with a wide variety of fax features at a low cost, check out Calculus's product line. The products are simple to operate, and the fax quality is clear.

CIRCLE 504 ON READER SERVICE CARD

Introducing the laser printer to buy if price is the first thing you look at,

or the last.

	The New IBM LaserPrinter E	HP LaserJet IIP
Speed	✓ up to 5 ppm	up to 4 ppm
Speed upgrade option	✓ up to 10 ppm	No
Adobe PostScript option	Yes	Yes
Printer emulation	✓ IBM, HP PCL	HP PCL
Std. plotter emulation	✓ Yes	No
Font card slots	✓ 2	1
Std. input paper tray capacity	✓ 200	50
Std. output paper tray capacity	✓ 100	50
Opt. sec. input paper tray capacity	✓ 500	250
Opt. envelope tray capacity	✓ 75	20
List price*	✓ $1495	$1495

*Dealer prices will vary.

Any way you look at it, the new IBM LaserPrinter E gives you more for your money than any other laser printer in its price range.

For the same price as the HP LaserJet IIP, the IBM LaserPrinter E gives you all the advantages of laser quality output 25% faster, with four times the paper capacity, and twice the number of font slots.

Plus the IBM LaserPrinter E is unique in its price range because it lets you customize your printer's speed and features to meet your exact needs. And that makes it the only affordable laser printer that lets you buy now and grow later.

For example, if you decide you want faster printing, you can double the LaserPrinter E's speed. Or if your software requires Adobe PostScript® language, it can give you that creative flexibility, too.

So whether your first requirement is price, performance or flexibility, the new IBM LaserPrinter E should be at the top of your shopping list. See it today by calling 1 800 IBM-2468, ext. 982, for the name of your nearest IBM Authorized Dealer.

The new IBM LaserPrinter E. Suddenly, nothing else measures up.

IBM®

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Finally, Somebody With All The Answers.

Why is the sky blue? How much does Isaac Asimov weigh? Why won't my Macintosh talk to my laser printer? How do you fold fitted sheets? How's the weather up there? Who put the bop in the bop-sh-bop-sh-bop? Where can I find the best steak in Chicago? How much is that doggy in the window? How is OS/2 going to affect me? Which hard drive is best for me? Will you marry me?

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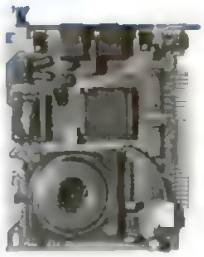
CIRCLE 226 ON READER SERVICE CARD

CARDINAL TECHNOLOGIES INC.

SendFax Modem 4800

by Kimberly Maxwell



You would understand the Cardinal Technologies' SendFax Modem 4800 better if you think of it as a standard internal modem board with the additional ability of sending faxes. The economical $249 SendFax Modem adapter card combines a V.22bis standard 2,400-bit-per-second modem with a 4,800-bps fax board and transmit-only fax software.

The SendFax Modem kit includes the adapter card, *FlashLink* telecommunications software and Bit Software's *BitFax* software for fax communications. If you have a favorite communications software package, you can use it with the SendFax modem instead of the *Flashlink* software. The fax board responds to the Hayes AT command set, making it compatible with any communications software.

The half-length adapter board uses a Digital Signal Processor and other state-of-the-art circuits to help reduce the card's size. The SendFax's surface-mounted technology also helps maximize the available space on the card.

FAX TRANSMISSIONS

BitFax includes the capability of sending multiple fax transmissions to different destinations. You may find *BitFax*'s phone book feature helpful when you need to call frequently used phone numbers. *FlashLink* uses a similar dialing directory menu for storing phone numbers, giving you the opportunity to send data at designated times.

You can control several items through software configuration, including activating or deactivating the modem speaker and the word processor you use for your documents. If you designate the type of word processor, *BitFax* reads the document and transmits it without having to convert it to an ASCII file.

BitFax includes a text editor but not a graphics editor. With the text editor you won't have to use a separate word processor, although of course it has its limitations. It lets you create, edit, or delete text messages, but not text formatted with boldface, underlining, or special fonts.

A print capture feature allows you to capture printer output from applications, such as *WordPerfect*, so that it can be sent in fax format. It intercepts the print command from the application and prints to a fax file instead of to your printer. The video capture feature works in a similar way: you can capture the displayed image on the screen to a file in .PCX format. After capturing it, you send the file as a fax. This comes in handy if you are using a program that does not save files in a format supported by *BitFax*. Supported formats include .DCX, .FAX, .IMG, .PCX, and TIFF.

A preview feature, enabled through software configuration, is helpful in viewing the fax during transmission. We noted a good readability of the fax on the screen as it went out. Once you convert a file into a fax file format, you can save it in that format. This lets you send the same fax to a string of different numbers.

THE DATA MODEM

FlashLink transfers files via modem from one PC to another. While uploading or downloading files, the product displays a meter showing transfer progress. *FlashLink* supports seven file-transfer protocols, including MNP Class 4 error checking and MNP Class 5 data compression.

The data modem automatically adapts to the data rate of the receiving machine and to the communications standard of the remote modem. The automatic tone or pulse-dialing feature distinguishes among dial tones, busy signals, ringing, and modem carriers.

Overall, Cardinal Technologies has put together a good combination that may be right for you if you are looking for a modem that can send faxes but not receive them. The efficient modem/fax solution is inexpensive and could play an important part in your fax-buying decision.

FACT FILE

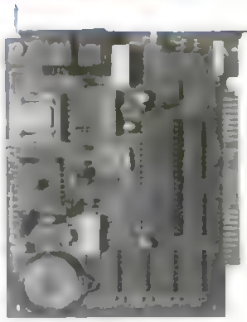
SendFax Modem 4800
Cardinal Technologies Inc., 1827 Freedom Rd., Lancaster, PA 17601; (800) 722-0094, (717) 293-3000
List Price: $249
Requires: 256K RAM, DOS 2.0 or later.
In Short: The SendFax Modem 4800 is a modem/fax combination with capabilities limited to sending but not receiving faxes. The fax transmission rate is 4,800 bps, and the modem's transmission rate is 2,400 bps.

CIRCLE 642 ON READER SERVICE CARD

CHOICE TECHNOLOGY GROUP LTD.

DeskFax Professional

by Mike Byrd



The DeskFax Professional, from Choice Technology Group Ltd., lives up to its name in that it lets you do it all, right from your desktop, for only $429. DeskFax Professional is an extension of the original DeskFax. Additional features including group broadcast, voice/fax detect, fax/mailmerge and DOS command-line routines for sending and receiving fax.

DeskFax Professional, contains almost every feature you would ever want in a PC fax system. As with the other products in this roundup, it lets you transmit faxes immediately or schedule them for later transmission. You can set up a phone book of frequently used names and can send multiple files, as well as merge them into a single file. These files can be a combination of ASCII as well as TIFF or .PCX files.

> DeskFax is an all-in-one operation, containing almost every feature you would ever want.

The product keeps a log of all transmissions and receptions, automatically trying again at a preset interval if the line is busy. DeskFax also allows you to configure it to automatically print received faxes or to store them on disk for later screening.

SIMPLE INSTALLATION

The well-illustrated manual guides you through installing the half-length fax card and software installation. While the card's default IRQ is COM3, you can set a DIP switch for COM4 if COM3 interferes with other cards in your system. You can adjust speaker volume through a knob on the

back panel of the board, a welcome feature.

The fax software consists of three parts: INSTALL, FAX.EXE, and the command line routines DFXTX and DFXRX. The main fax program, FAX, is a TSR that achieves background operation through "time slicing," or sharing the CPU.

FOREGROUND MODE

If you want to transmit or receive faxes in foreground mode, DFXTX and DFXRX offer these capabilities via command line instructions at the DOS prompt.

These time-saving routines are not RAM-resident; once you have manually sent or received a fax, they remove themselves from memory until you need to run them again.

When you initially execute FAX.EXE, you get a brief window display of the software version installed before returning you to the DOS prompt. The background portion is quite hefty at 179K. FAX.EXE monitors the fax board hardware for receipt of any incoming calls. It also monitors the computer clock for comparison with scheduled fax transmission times. At the scheduled time, the software automatically sends the fax without interrupting the current application program in the foreground.

FILE CONVERSION

DeskFax Professional's software works with four different file types: ASCII, Epson FX-80 print files, monochrome .PCX, and TIFF. No manual conversion to fax format is necessary, since the software automatically converts all of these file types to fax format at the time of transmission. The software also has a utility to convert fax files back to .PCX or TIFF for subsequent editing.

A worthwhile feature is the product's ability to capture Epson FX-80 print data from any application. When enabled through a hotkey sequence, the background module will intercept the application's print file and automatically convert

FAX BOARD OUTPUT: JUDGING IMAGE QUALITY

Image quality is one selling point of fax boards, since theoretically the received image is sharper when sent by a fax board than a standalone machine. The fax board, after all, already stores the image and thus avoids scanning—an extra step that a standalone requires. The fonts used in transmitting text further differentiate one product from another.

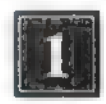
The subjective ratings listed alongside each product's name are the collective work of a panel from PC LAN Labs. The panel's members compared how well each product transmitted our test image, a 120K .PCX file containing circles, small text, and line drawings. They examined a standard series of points on the received page to judge the image's density, linearity, and degree of clarity.

Two companies, American Data Technology and Calculus, each have two products included in this review. The compared output, however, from each set of two was so similar that we included only one sample for each company.

A printout of the same file output from an HP LaserJet II is included for comparison.

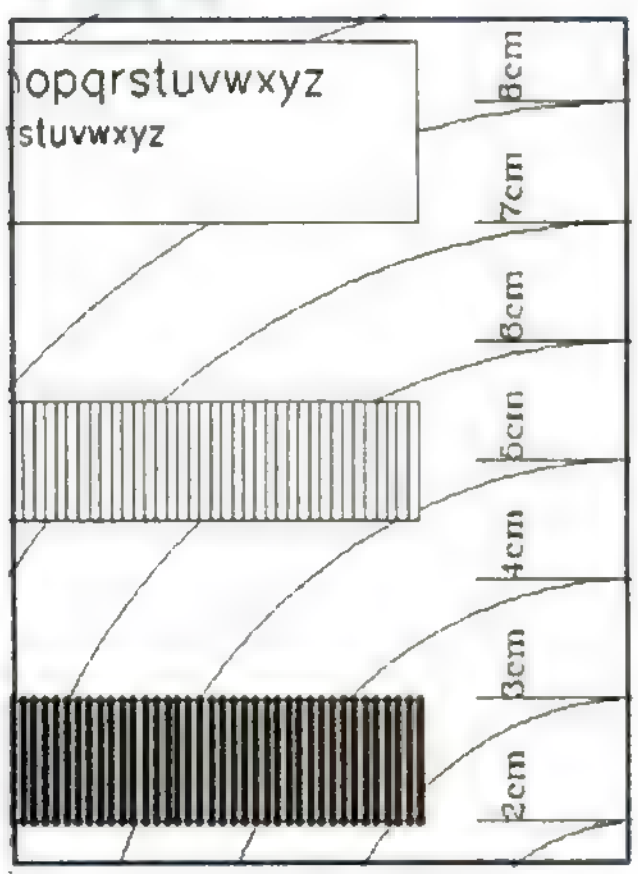
The image was sharp, dark, and linear.

The image had problems with linearity.

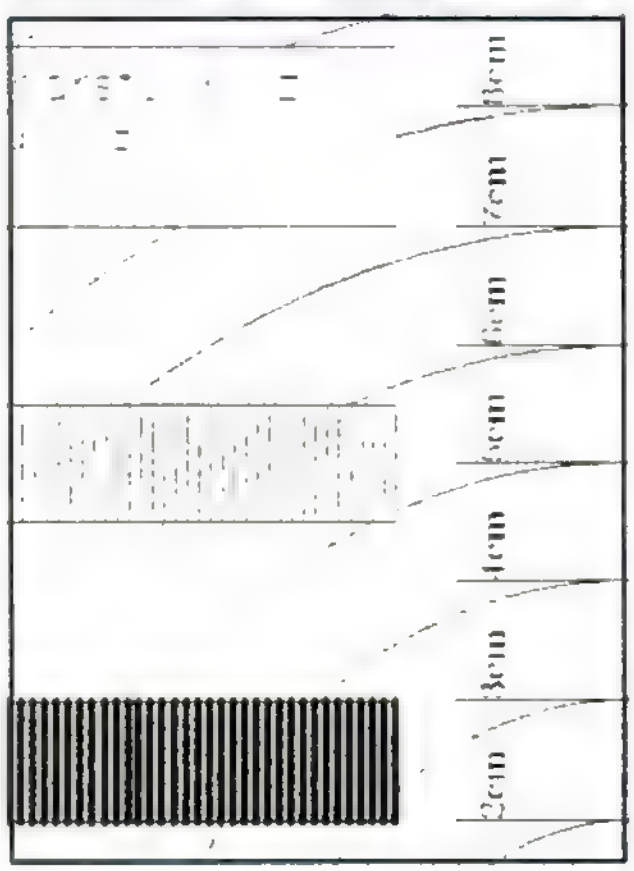


The image suffered from missing dots and lack of sharpness.

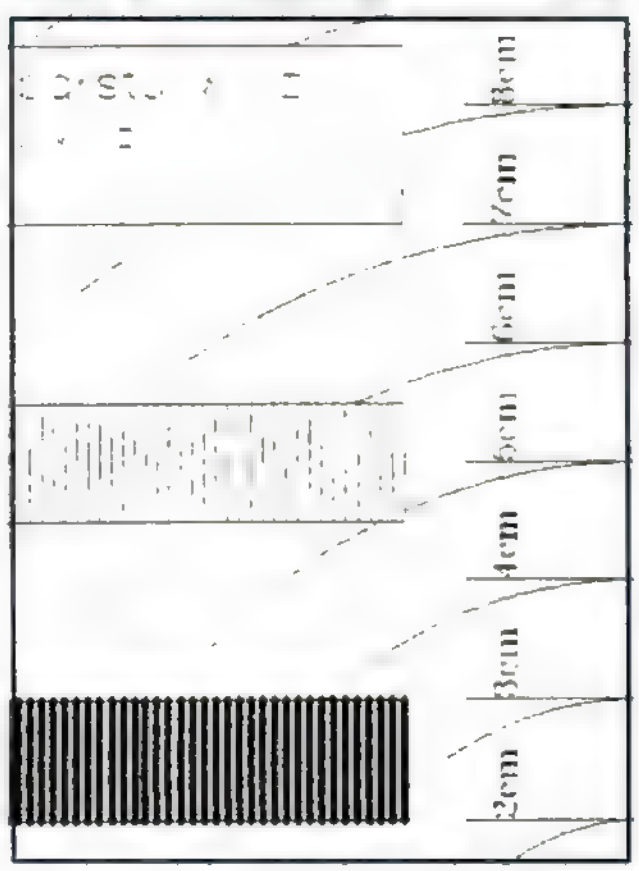
HP LaserJet



Connection CoProcessor 3



DeskFax Professional 3



FACT FILE

DeskFax Professional
Choice Technology Group Ltd., 11545 West Bernado Ct., #200, San Diego, CA 92127; (619) 487-5640.
List Price: $429
Requires: 256K RAM (hard disk recommended); CGA, EGA, VGA, or Hercules graphics; DOS 2.0 or later
In Short: DeskFax Professional is professional both in features and operation—a complete package offering background send and receive, group broadcast, file merging, and applications print capture of Epson FX-80 print data. One to consider.

CIRCLE 643 ON READER SERVICE CARD

it to fax format for immediate or subsequent transmission.

Another helpful feature is a periodic audio alert notifying you that you have an inbound fax waiting.

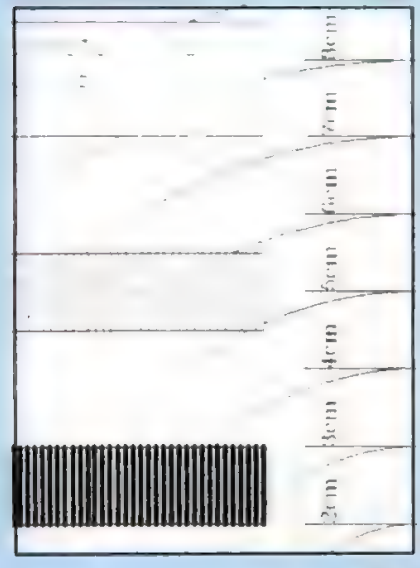
The only real bug we found during testing turned up when we were using our HP LaserJet. When receiving a multiple-page fax, the first page printed well, but the subsequent pages were garbled. The whole fax was intact in a disk file—fine for viewing or for printing to a dot matrix printer—but it just wouldn't print correctly on the laser printer.

One feature that may initially seem distracting is the operation of the foreground fax program. When you schedule an immediate fax transmission, nothing happens until you leave the DeskFax foreground program.

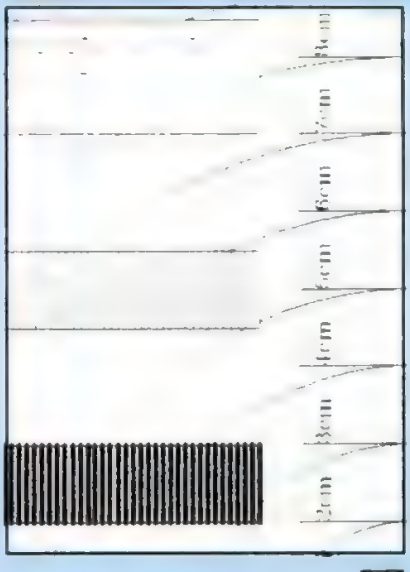
The background program, in fact, sends the fax—but only after you return to DOS or to your application.

Once Choice Technology fixes its LaserJet bug, you'll find that the DeskFax Professional system offers virtually every feature you need, from sending the same fax to multiple parties to on-the-fly fax transmission from any applications package. Its RAM-resident program is a hog at 179K, but otherwise the product is a worthy choice.

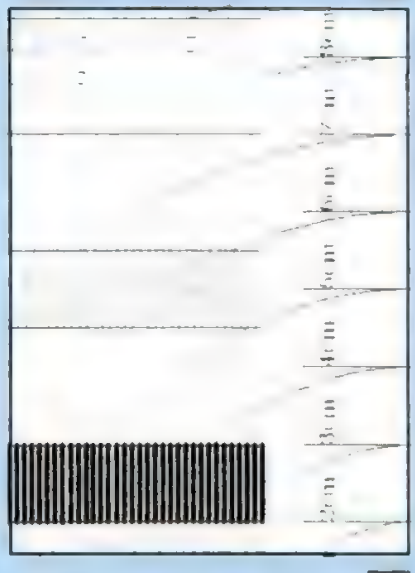
EZ-Fax series 3



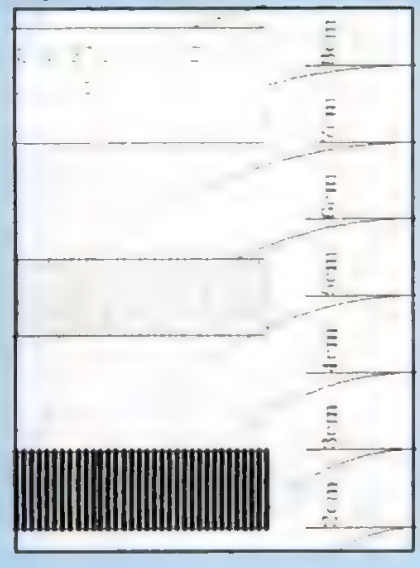
FAX96 3



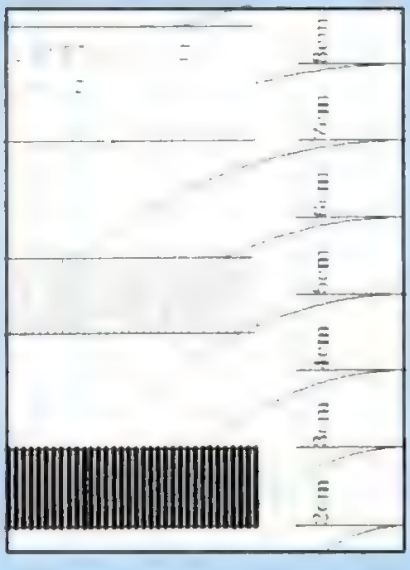
FaxPro I 3



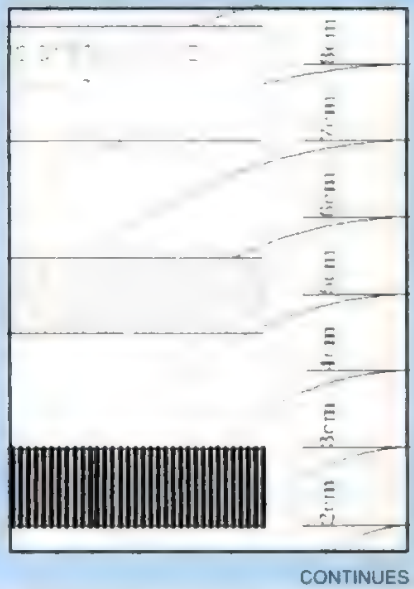
Hayes JT Fax 4800B 3



ProModem 2400BFAX 3



SendFax Modem 4800 3

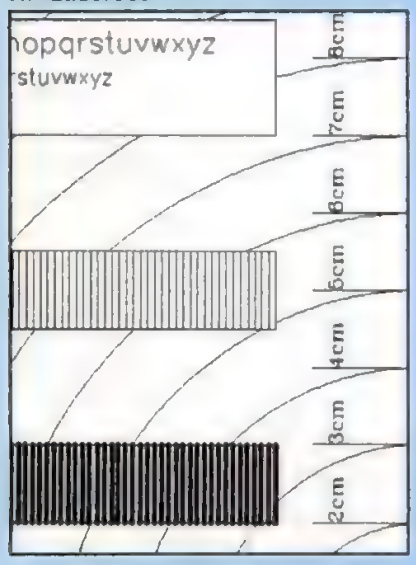


CONTINUES

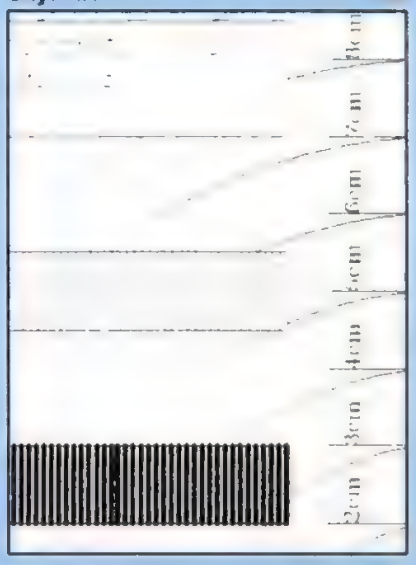
FAX BOARD OUTPUT: JUDGING IMAGE QUALITY

CONTINUED

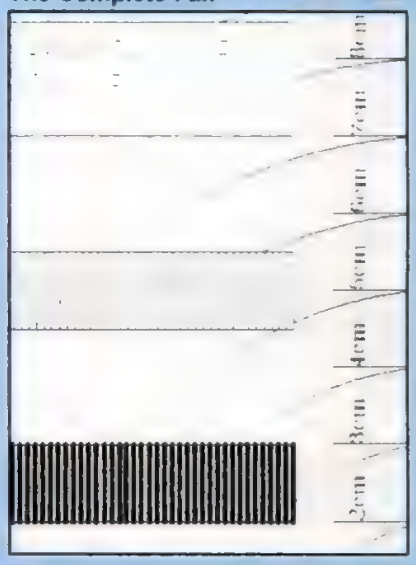
HP LaserJet



SkyFAX 3



The Complete Fax 3



THE COMPLETE PC

The Complete FAX

by Mike Byrd

Need a low-cost, complete PC fax? The Complete PC offers its Complete FAX, or CFAX, package at a fraction of what you'd pay for its more expensive stepbrother, the CFAX/9600. Priced at $399, CFAX offers true background operation while sending and receiving faxes and executing other applications in the foreground. You can send faxes on the fly from within most of the popular word processing and spreadsheet programs.

Complete is not just part of the CFAX name; it applies directly to CFAX's stable of features. CFAX lets you send faxes whenever you wish, scheduling them for hours when you'll pay lower phone rates. It automatically redials busy numbers and can send a list of documents to one fax machine or to a whole group of recipients.

CFAX also makes it easy to receive faxes. Whether you are working at or away from your PC, CFAX answers the phone, initiates reception, and notifies you with a beep and an on-screen prompt that you have a new fax waiting.

VIEWING DOCUMENTS

You can view fax documents on your PC for privacy or print them at your leisure on plain paper with your laser or dot matrix printer. All incoming and outgoing faxes are date- and time-stamped.

CFAX maintains a directory of frequently called fax numbers and lets you create named distribution groups for easy calling. It can automatically add a cover sheet or, if you have a short message, send the whole message on the cover sheet.

The CFAX status screen lets you monitor the status of fax activities. From it, you may check the progress of file conversions, examine the print queue, and verify the amount of hard disk space remaining.

You can also use CFAX's status screen to see a detailed log of incoming and outgoing faxes and control printing, sending, and receiving.

CONVERSION OPTIONS

CFAX provides automatic and manual conversion of files to and from .CUT (*Dr. HALO II*), .PCX (*PC Paintbrush Plus*), and .MSP (*Microsoft Paint*) format. CFAX also converts fax files to TIFF format and ASCII and Epson FX print files to fax files.

One of CFAX's most powerful features is the ability to send a document directly from within an application; a hotkey accesses a pop-up window. CFAX even uses formatting such as boldface and underline when sending the fax—a feature you won't find in many products.

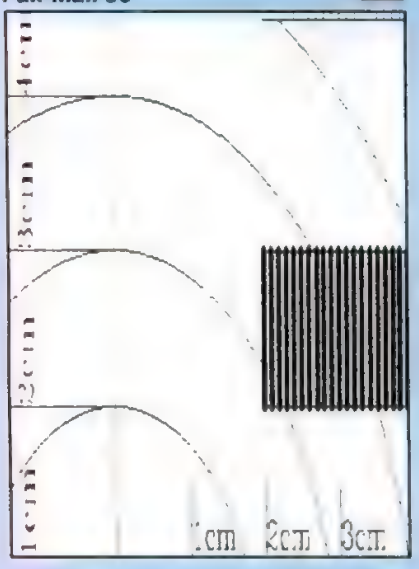
Other features include sending, creating, viewing, and printing faxes directly from the DOS prompt; polling other fax machines for messages and responding to their polling; and high-speed binary file transfers between CFAX boards.

FACT FILE

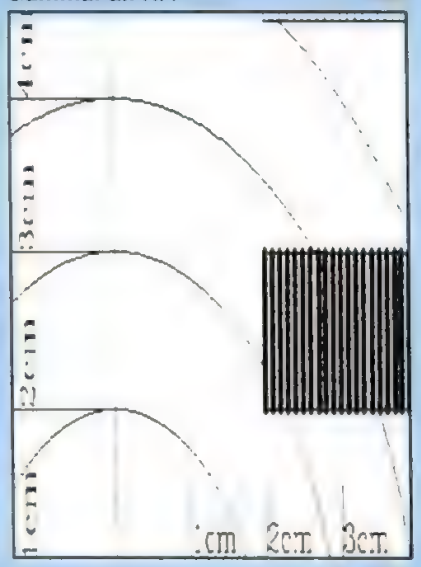
The Complete FAX
The Complete PC, 1983 Concourse Dr., San Jose, CA 95131; (408) 434-0145.
List Price: $399
Requires: 512K RAM; hard disk; Hercules, CGA, EGA, or VGA graphics; DOS 3.1 or later.
In Short: The Complete Fax offers a combination of features usually found only in more expensive PC fax packages. It offers true background operation, on-the-fly fax transmission from within applications, and file conversion among several of the popular graphics formats. Definitely one to consider.

CIRCLE 644 ON READER SERVICE CARD

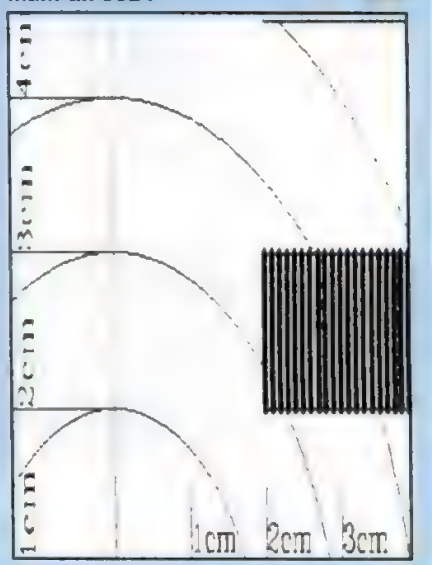
Fax-Mail 96



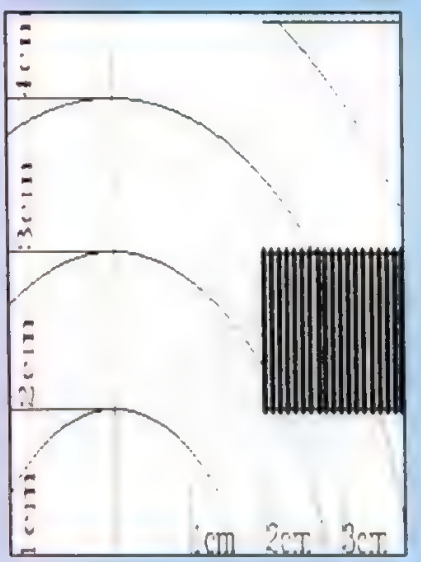
GammaFax NA



MaxFax 9624



SmartFax series



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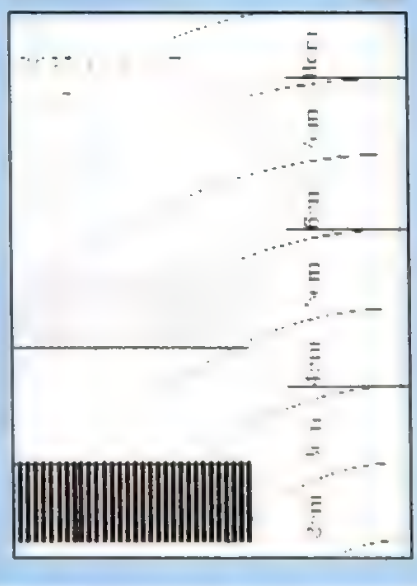
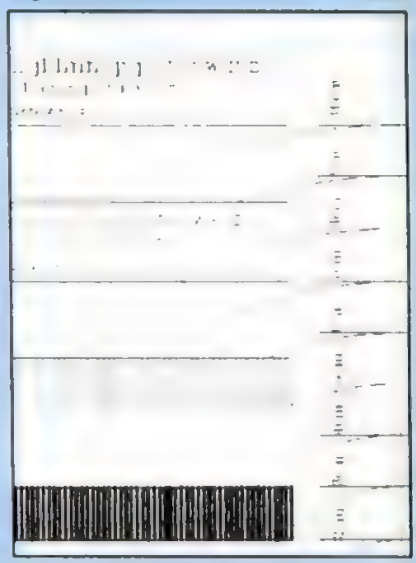


Lightfax 9624BH



HARDWARE INSTALLATION

Hardware installation is easy, the hardest part being to select the I/O address on the ¾-length board. Nevertheless, the default jumper settings usually makes this easy, too. Installing the software also isn't difficult, but if you need help, the manual gives clear and concise explanations. An added benefit is that CFAX comes with a two-year warranty and provides technical support via phone or mail.

The CFAX software consists of two modules: *CFBack* and *CFAX*. *CFBack* is a 58K RAM-resident module that runs the background fax send and receive, including the pop-up menu that you access from within your application. The other module, CFAX, is the foreground program for accessing all CFAX functions. Menu displays are intuitive and clear, with context-sensitive help always available through F1 if needed.

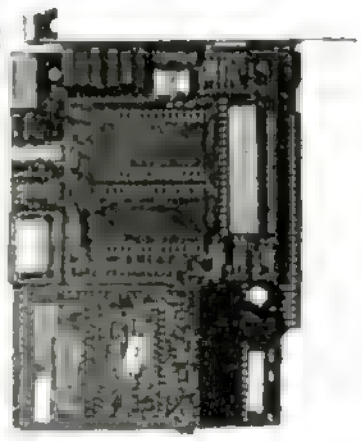
CFAX is rated only at 4,800 bps, but our performance tests showed comparable performance to many of the 9,600-bps boards. Print quality is excellent, both on-screen and through the printers. These results, plus its ample, well-designed features, make CFAX a must for a complete FAX package consideration.

From background operation to on-the-fly fax transmissions, CFAX does it all: the most features for the lowest price.

COMPUTER FRIENDS INC.

Lightfax 9624BH

by Randol Tigrett



Lightspeed Technology's Lightfax 9624BH, distributed by Computer Friends, differs from the other fax products reviewed here in that it's a *Microsoft Windows* application. If you've used *Windows*, you know that a fast click of the mouse can manipulate screens to manage all or part of an application's input and output.

The $449 Lightfax has everything you need to bring up the fax *Windows* application. First, there's no need to buy the latest version of *Windows*; Lightspeed includes a runtime version. If you already have the latest version, just include a path statement in your AUTOEXEC.BAT file for your *Windows* and Lightfax subdirectories, in that order.

The complete package comes as a set of seven 5.25-inch floppy disks. Its half-length, 8-bit fax adapter card uses the Rockwell chip set.

MANY GOOD FEATURES

The Group 3 Lightfax package comes with many good features. The background send and receive functions work while you are in another *Windows* application. The drawback, however, is that it halts all processing of the foreground application until the fax has been sent or received. During busy tasks like multiple transmissions, this can be a nasty problem for high-production applications.

Among other features, Lightfax incorporates the ability to transmit multiple files and group faxes. A page editor allows you to write text, import graphic images and send the completed package as a fax. Included in the product is *Namecard*, a phone directory program.

We found Lightspeed Technology's polling feature nice for offices keeping a tight telephone budget or needing extra security. The Polled ID feature lets your fax machine accept or reject incoming calls, thereby receiving only transmissions from machines with correct IDs. The same feature works during transmission, as well. It helps prevent illegal reception of your fax files, which is a legitimate concern for many organizations these days.

Lightfax lets you pick a file to view from the directory listing: simply point and shoot to the directory and file you want to view. While we found viewing images with the rescale feature to be a big plus, we hit a snag with the annoying 1- to 2-second delay while it redrew the image after moving either the scroll bar or preview window. The preview feature shows a smaller version of the image: by moving the small box around the window, you show the area you want displayed in the main window.

Lightfax's fax conversion from .PCX format to fax may be the fastest we reviewed, but it has serious problems. The product does convert between ASCII, *Windows* text, TIFF, .MSP (*Microsoft Paint*) and .PIC (*Lotus 1-2-3*), to name a few. Nevertheless, the main problem was in the quality of the transmitted fax image. The trade-off between conversion and transmission speed versus a quality fax is lost with this version of fax software.

FACT FILE

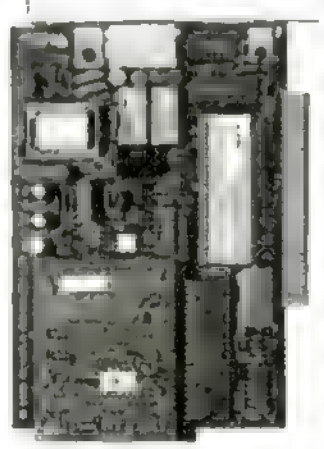
Lightfax 9624BH
Computer Friends Inc., 14250 Northwest Science Park Dr., Portland, OR 97229; (800) 547-3303.
List Price: $449
Requires: 640K RAM, hard disk, *Windows*-compatible graphics monitor, DOS 2.1 or later.
In Short: The only under-$500 *Microsoft Windows* fax application, distributed by Computer Friends for its maker, Lightspeed Technology. Fast transmission and conversion of graphics to fax format, but with poor-quality fax image.

CIRCLE 645 ON READER SERVICE CARD

ESCO SYSTEMS INC.

SkyFAX

by R. Dennis Boatner



ESCO Systems' SkyFAX, priced at $399, is a full-featured PC fax adapter card that offers convenience, ease of use, and advanced functions. The 9,600-bit-per-second fax adapter is a half-length board, and the single telephone connector uses a standard RJ-11 modular hookup.

You can send faxes to clients with SkyFAX without manning your PC. A time-sensitive scheduler lets you queue faxes for delayed transmission at lower telephone rates.

The software installation is simple; it essentially installs itself. SFINSTAL asks questions about your system configuration, determining the proper jumper and switch settings before you install the hardware. Installation is done once you place the adapter card into an 8- or 16-bit slot.

MENU DISPLAY

The SkyFAX menu display is well-designed. It uses title and status lines, and the middle section of the screen displays a function menu. You can activate the online help feature by using a function key.

SkyFAX offers both automatic and manual document conversion, translating numerous file formats to fax format in 30 seconds. The fine-transmission mode time ranks among the best, at a fast 98 seconds for a 120K file. SkyFAX converts files to and from .CUT (*Dr. Halo II*), .PCX (*PC Paintbrush*), .MSP (*Microsoft Paint*), and .IMG (*GEM Paint*). SkyFAX also converts fax files to TIFF format, .SSC (SkySCAN Image Format), ASCII, *Wordstar* (versions 3, 4, and 5), Epson LQ Text Print File, and Epson LQ/FX Graphics File.

SkyFAX's only real drawback is its inability to fax a document directly from within an application. SFPD, the memory-resident portion of the SkyFAX software, intercepts all data sent to the LPT1 port and prints the document to a disk file. After exiting your current application, this disk file is ready for immediate faxing or delayed transmission scheduling.

Other features include a text editor for document updates, the ability to fax documents immediately, a delay feature used with the fax scheduler, and a background fax reception feature. There is a viewing and editing feature for your fax image files that you can use to fine-tune your images so that they are clear and can be sent at the fastest possible speeds.

The dialing directory in most fax adapter software packages is limited; however, SkyFAX allows 1,000 entries per dialing directory. Once a directory is full, you can create additional telephone directories.

UTILITIES MENU

The SkyFAX utilities menu allows you to create and edit mailing lists, character fonts, and country code tables. Within the

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New!

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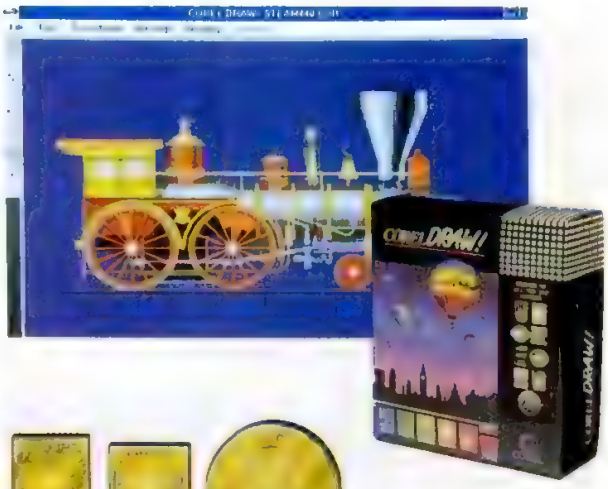
- Supports all popular color printers and slidemakers. Full PANTONE* and CYMK Color support for color separations



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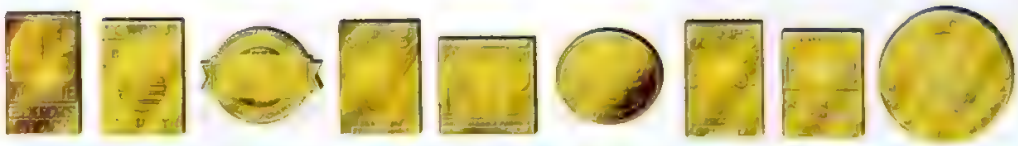

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CIRCLE 496 ON READER SERVICE CARD

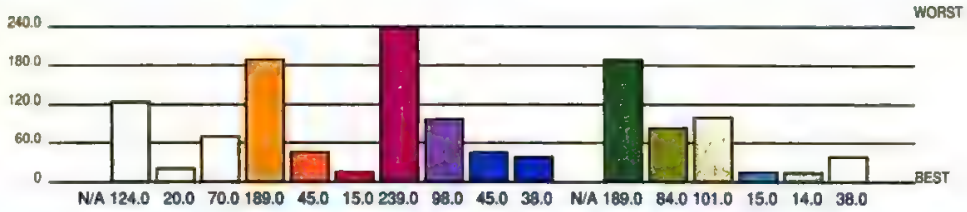
PERFORMANCE TESTS: FAX BOARDS

Transmission speed is important in choosing a fax board, but our benchmark tests—coupled with output samples for each product—demonstrate how the fastest products may be compromising image quality. Also, certain 4,800-bps products outraced their 9,600-bps competition.

.PCX-to-Fax Conversion

Elapsed Time (seconds)

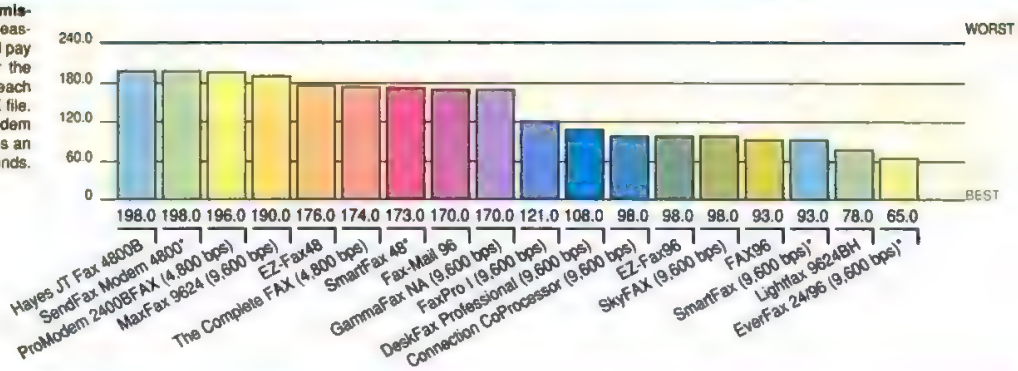
For both tests, we used a 12-MHz Dell System 200 for transmission and a Murata Business Systems F20 for reception. During the **.PCX-to-Fax Conversion** test, we observed the Dell System 200's screen and hard disk access light and timed the conversion process using a stopwatch. Our 120K test .PCX file contains a graphic image with fine lines and detailed print.



Fine-Resolution Fax Transmission

Elapsed Time (seconds)

In the **Fine-Resolution Fax Transmission** test, we used a stopwatch to measure the connect time (for which you'd pay on your telephone bill) required for the transmission of our test file, which each system converted from a 120K .PCX file. Since the connect time includes modem handshaking and verification, there is an unavoidable minimum of 5 to 10 seconds.



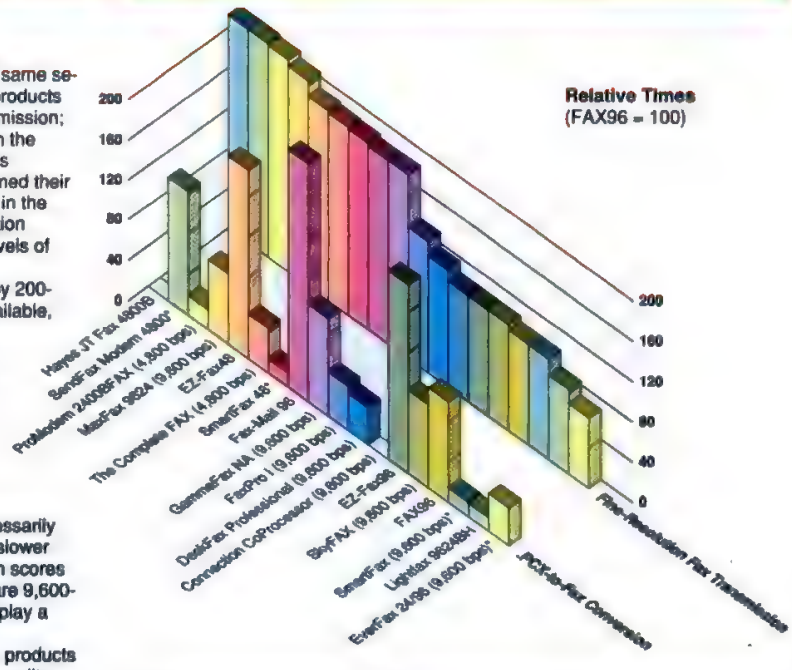
PERFORMANCE TESTS: COMPOSITE VIEW

Fax boards and their accompanying software don't all follow the same sequence of steps to prepare documents for transmission. Some products translate from the original file format to a fax format during transmission; others translate before they connect. For our tests we timed both the conversion and the actual connect time, but two products—Intel's Connection CoProcessor and the Hayes JT Fax 4800B—performed their conversions on the fly. The added connect-time delay is evident in the 4,800-bps JT Fax's results, but, to the credit of the Intel Connection CoProcessor, the CoProcessor still soared close to the upper levels of the products tested, even with the conversion time built in.

While PC LAN Labs chose each product's fine mode (200- by 200-dot-per-inch resolution) for fax transmission whenever it was available, two products—Cardinal's SendFax Modem 4800 and Everex's EverFax 24/96—could transmit only in normal mode for our particular test suite. Consequently, their results reflect the rates for normal-mode transmission, which would tend to be faster than those for the higher-resolution fine-mode image. And although American Data Technology's SmartFax cannot convert an image to fine-resolution mode, it can both transmit and receive in fine resolution.

Note that although a 9,600-bps rating is twice that of a 4,800-bps model on paper, the transmission speeds do not necessarily break down so neatly. True, the 4,800-bps boards make up the slower half of the products tested, but as you can see from transmission scores above the 139-second mean, a full third of the slower products are 9,600-bps models. This finding indicates that factors other than speed play a role in a fax board's overall performance.

Compare these results with our sample output. The only two products given a "1" rating—which indicates relatively poor transmission quality compared with our test fax machine, a standalone Murata—were the two fastest: the EverFax 24/96 and the Lightfax 9624BH.



N/A—Not applicable: this board converts data to fax format during transmission.

* Normal-mode resolution times are reported.

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1. Open the foldout page
2. Insert this sheet with
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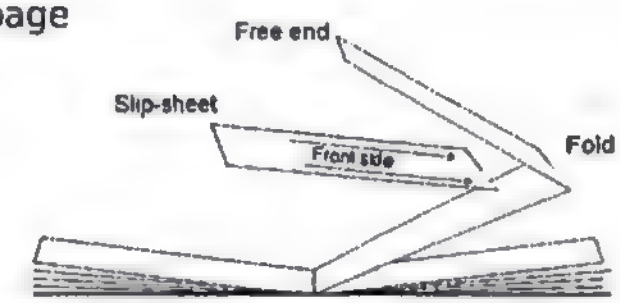
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

Inverted Back

1. Follow instructions on the other side

GbsSlipBack-0018

Back

1. Follow instructions on the other side

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Reason #2

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In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

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Now you can send for your own ZEOS Credit Card. It works just like a MasterCard or Visa for ZEOS purchases.

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Mail the completed Personal Information Organizer to:

ZEOS International
Z·CARD Processing Center
530 5th Avenue, N.W., St. Paul, MN 55112

a. Your Personal Information

Requested Line of Credit $ _____

Your Name _____ First Initial Last — Date of Birth _____ Mo Day Yr.

Present Address _____ Street Apt. # City State Zip

Social Security Number _____ ( ) Home Phone

Date of Residence _____ Month Year — Monthly Payment $ _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

Dates of Residence _____ From To

Your Employer _____
(If self-employed, see rear panel.)

Date of Employment _____ Mo. Yr — Position _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

Previous Employer _____ Address _____

Dates of Employment _____ From To

Other Income _____ I have received since (Date) _____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation.

Monthly Income _____ Gross $ Net $

Name and Address of Nearest Relative Not Living With You _____

Relationship _____

b. Credit Information

Include joint information, if joint account requested

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Loan Reference _____ Bank Name Address

Payment Balance

Bank Card Reference _____ Bank Name Address

☐ VISA ☐ Mastercard Payment Balance

(please check appropriate box):

☐ **Joint Credit** with another person. Complete all information.
☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history.* This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card Reference _____ Bank Name Address

Payment Balance

Other Credit References _____ Payment Balance

Account No. _____ Expires

Driver's License No. _____ State Expires

c. Joint Personal Information

Joint Name _____ First Initial Last

Date of Birth _____ Mo. Day Yr. — Social Security Number _____

Address _____ Street Apt. #

City State Zip

Date of Residence _____ Mo Yr. — Home Phone ( )

Employer _____

Date of Employment _____ Mo Yr. — Position _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

d. Self-Employed Information

Complete this section only if you are self employed

Business Name _____

Business Address _____

☐ Proprietorship ☐ Corporation ☐ Partnership — Business Phone ( )

Description of Business _____

Your Position _____ — In Business Since _____

Your annual income from business _____ — Business' annual income _____ (gross) (net)

You must provide at least one of the following:

1. Business Bank _____

( ) Telephone — Personal Banker's Name

2. Accountant's Name _____

( ) Telephone

3. Financial statement on business attached.

(EXC. AK, & HI)

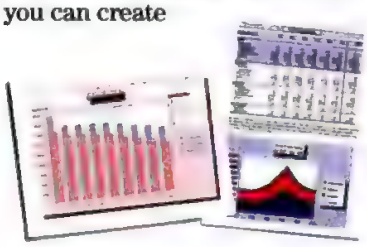
CIRCLE 745 ON READER SERVICE CARD

Monet, not money.

The HP PaintJet. $1395.*

Who says fine art is out of reach? The HP PaintJet color printer produces brilliant color for a price any business can afford.

So now there's no limit to what you can create



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There is a better way.

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CIRCLE 326 ON READER SERVICE CARD

SkyFAX software, a copy-and-delete file function resembles a hard disk manager. You can also print a communications journal showing all fax activity.

If you have a standalone fax machine in the office, SkyFAX can use it as a scanner. You can create letterhead or logo files and generate faxes up to 132 columns wide. You can create line drawings for your faxes and decrease your fax sending time by using different or smaller fonts included within the software. Procedures on how to use the Print-to-Fax option with *Microsoft Windows* are outlined in the software.

The user manual is well documented but contains confusing verbiage in some areas. There isn't an index; adding one would assist in operation. SkyFAX has a limited 12-month warranty covering defects in materials and workmanship.

SkyFAX has ample faxing capabilities as long as you don't require faxing from within an application. Its ease of operation and added utilities make this a definite contender in the PC fax board market.

FACT FILE

SkyFAX
ESCO Systems Inc., 540 Weddell Dr., #2, Sunnyvale, CA 94089; (408) 744-9001.
List Price: $399
Requires: 512K RAM; hard disk; CGA, EGA, VGA or Hercules graphics; DOS 2.1 or later.
In Short: SkyFAX offers a good package of options, and its performance is equal to that of the more expensive boards. The only drawback is the inability to fax from within an application.

CIRCLE 646 ON READER SERVICE CARD

EVEREX SYSTEMS INC.

EverFax 24/96

by Mike Byrd

Want the best of both worlds? The EverFax 24/96 from Everex Systems offers the best of fax and modem communications in a single product. Not only do you get Group 3 9,600-bit-per-second fax capability, but you also get a 2,400-bps Hayes-compatible modem with MNP Class 5 data compression and error correction. Having both of those functions in a single package gives you a lot of communication capability for a very attractive $399 price.

EverFax automates the process of faxing. You can send documents to your field office or clients and schedule the transmission to take advantage of lower (overnight or weekend) phone rates. You can also automatically collect sales reports from your district managers overnight.

The EverFax kit comes with a full-length card, three manuals, four disks, and a telephone connector. Software consists of two modules: KEYFAX and EFAX. KEYFAX is the RAM-resident module, occupying 95K of RAM. It gives you continuous fax send/receive capability, as well as a pop-up menu for fax transmissions from within other applications.

EASY INSTALLATION

Installing the card is easy, and the manual, amply illustrated with pictures, includes extensive detail for trouble-shooting any installation or hardware problems.

Everex is the only company we found that solves the problem of selecting a COM port. First, before installing your card, you run a utility program that checks out what devices are using the serial ports and their respective interrupts. Next, you can select COM1 through 4 through two DIP switches, accessible on the card's rear bracket. There is no guesswork, and the scheme appears to be relatively foolproof.

Once the system is installed, the EverFax 24/96 has virtually all features most users will require. Among them:

- The EverFax merges multiple text and graphics files for a single transmission, which gives you the option of adding letterhead and signature graphic blocks to your document.
- The system automatically retries if the called phone number is busy. You can create and maintain phone lists and distribution lists to send the same set of documents to groups of addressees.
- The EverFax automatically generates cover sheets and page headers, although you can select one of several previously generated cover sheets.
- You can send documents directly with the EverFax from within other application programs through a pop-up menu. The EverFax also allows you to scan documents using one of its supported scanners for either immediate or later transmission.
- The EverFax includes a RAM-resident module used to receive and send faxes while other application programs are in use. It maintains a log of transmitted and received faxes, as well as a status log of faxes awaiting transmission. The EverFax can poll other fax machines for documents to download.
- The EverFax supports three graphics file formats: .PCX (*PC Paintbrush*), .IMG (*GEM*), and TIFF. These files, however, must be converted manually to the fax image file with EverFax utility routines prior to transmission.

We found the received fax viewing feature the best we have seen in any PC fax package. The letters on the screen were sharp and distinct, and you have the option of changing line height from full to thin. You also can shrink the display horizontally and vertically.

One feature not often seen in PC fax packages was the option to remove the RAM-resident KEYFAX from memory when exiting EFAX. Other programs allow you to remove their RAM-resident modules, but usually from the DOS command line.

MIXED REVIEWS

One missing feature is the fine-resolution (200 by 200 dots per inch) mode of transmission and reception. Another is that the EverFax does not provide background operation. Even though KEYFAX is RAM-resident and another application may be running, no fax communication can take place in the background. When KEYFAX pops up to alert you to an impending fax transmission or receipt, it takes over the operation of your computer.

The EverFax's performance was very good in the normal-resolution timed test. Printer quality was also noteworthy for normal resolution, but it suffers from not having fine-resolution capability for complex graphics figures.

FACT FILE

EverFax 24/96
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (800) 821-0806.
List Price: $399
Requires: 512K RAM; hard disk; CGA, EGA, VGA, or Hercules graphics; DOS 2.0 or later.
In Short: The EverFax 24/96 is an excellent combined 9,600-bps PC fax card and 2,400-bps modem with MNP Class 5 data compression and error correction. The fax capabilities—including broadcast, phone directory, distribution lists, and graphics and text merge—make this package a potent performer in both leagues.

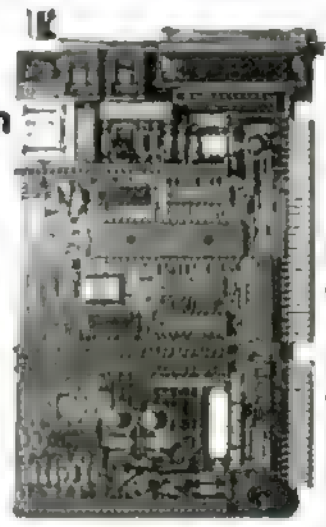
CIRCLE 647 ON READER SERVICE CARD

The package offers superb fax and modem capability, and its MNP 5 protocol offers a significant reduction in data transfer times. On the fax side it offers almost every function you'll ever need. If you are short of slots in your computer, the EverFax is an attractive option, both in price and performance.

THE FAX GROUP

FaxPro I

by M. Keith Thompson



FaxPro from The Fax Group is a modular software and hardware PC fax solution. The Fax Group markets a variety of fax and modem combinations, but our review focuses on the $399 FaxPro I. The most notable advantages of this product are its ease of use and broad hardware support.

Installation for both the hardware and software is quick and simple. One DIP switch sets the COM port address for the fax card, and another enables the optional Hayes-compatible modem. Unfortunately, The Fax Group neglected to label the line and phone jacks on the card. This creates some confusion if you decide to move the computer and do not have the manual handy.

The installation routine politely asks if you want to modify your CONFIG.SYS and AUTOEXEC.BAT files. The setup procedure requires a little more user input. You simply answer a few questions regarding your preferences, then enter fax machine phone numbers into your phone book.

Like most of the other products tested, FaxPro allows you to fax documents from within your application. When you invoke your program's print routine, the FaxPro TSR intercepts the data going to your printer and translates it into a fax image. With the FaxPro software loaded, you have the choice of printing, faxing, or both—since you may want a hard copy of what you faxed.

The FaxPro I does a good job on both viewing received faxes and printing them. Users can page through the fax on-screen a section at a time. Managing the incoming files is easy with the system's point-and-shoot menus.

HANDS OFF THE KEYBOARD

The documentation warns against excessive keyboard activity while the FaxPro does lengthy processing. Sure enough, pounding away on the keyboard while a fax transmission is in progress causes the system to crash. Since most users do not read the manual, they might learn this quirk the hard way. We would like to see The Fax Group make its software more foolproof.

With most software programs, updating to newer versions can be a trying experience, but The Fax Group's customer service department automatically updates your FaxPro software by telephone. The company uses the fax phone number from your registration card to call in and download the new software to your computer. Of course, for security reasons, you have a menu option that you can use to deny access to The Fax Group and any other unauthorized caller.

For advanced faxing, the FaxPro I includes a set of script commands that let you create batch files or specialized header files. These may contain the phone number and the date and time to fax a document; you can also add a letterhead and signatures. Other commands let you create distribution lists and handle automatic transmission of multiple faxes.

As with any computer peripheral, customer support makes or breaks the product. In addition to the dealer's network, customers receive informed technical advice over a toll-free support line.

With the FaxPro I's ease of use and modular design, it fits well into most office environments. Novices will appreciate the well-organized menus and icons, while experienced users will like its flexibility. Toll-free support and high-quality output are also big advantages.

FACT FILE

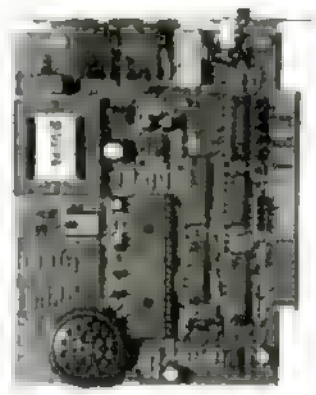
FaxPro I
The Fax Group, 12625 High Bluff Dr., #111, San Diego, CA 92130; (619) 792-6400.
List Price: $399
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: The FaxPro I combines high-quality output and ease of use. A short time from out of the box to your first fax makes the FaxPro a winner.

CIRCLE 648 ON READER SERVICE CARD

FREMONT COMMUNICATIONS CO.

FAX96

by Mike Byrd



Just as Victor Kiam of Remington personalizes ads for his company's shaver, Paul Masters, president of Fremont Communications Co., puts his picture on the front of his FAX96 package. The package displays his photograph in a reclining position, but don't be fooled: Paul Masters stands tall for the $195 FAX96, which offers most of the capabilities found in PC fax cards selling at $600 and higher.

Easy, simple, and basic describe the operation of the FAX96; however, these words only begin to describe its abilities. Fremont Communications' FAX96 offers you PC fax transmission and receipt, the option of generating an automatic cover sheet, automatic redial if the called number is busy, and much more.

You can select multiple receivers for single or multiple documents. Each new name and phone number automatically updates the phone directory; subsequent use of that name can be done by point and shoot, using the curser to select the number you want to dial. The FAX96 automatically catalogs directories and files to help you locate a file to fax.

FACT FILE
EDITOR'S CHOICE

FAX96
Fremont Communications Co., 46309 Warm Springs Blvd., Fremont, CA 94539; (415) 438 5000.
List Price: $195
Requires: 384K RAM (640K recommended); hard disk; CGA, EGA, VGA, or Hercules graphics; DOS 2.1 or later.
In Short: Fremont Communications' FAX96 provides the most PC fax system for the money, giving you features found in more expensive counterparts. Menus for sending and receiving faxes, broadcasting, chaining files, viewing, and printing faxes are easy and intuitive.

CIRCLE 649 ON READER SERVICE CARD

READY TO RECEIVE

Even if you are in another program, such as *WordPerfect* or *Lotus 1-2-3*, the FAX96 is always ready to receive: it simply displays a small window indicating an arriving fax. Unfortunately, it suspends your application program to receive the fax.

Laugh, sob, growl, warble, wail (or just talk) across your LANtastic PC Network.

The newest version of our LANtastic PC network has really got people talking.

You see, LANtastic is the first PC network to support Voice. So you can actually send voice messages from one PC to another across the LAN.

It's easy. Just pick up the telephone handset provided with the LANtastic Voice Adapter (sold separately at $149* per adapter), bring up a handy menu, and talk. Use Voice Chat to carry on a realtime conversation or save the voice message in a digital format for playback later in your own voice—just like regular E-mail.

Only LANtastic has Voice. And Voice is just one of the reasons people are talking about LANtastic version 3.0.

Another is our new easy installation program that'll have you up and running in minutes.

And disk caching to boost network speed.

Plus enhanced printing, E-mail, security and more.

All of which led PC Magazine to conclude: "LANtastic blows away the DOS-based competition in terms of performance."

—May 29, 1990

And don't worry. Even with all these new features, LANtastic still has the smallest RAM overhead of any network.

LANtastic version 3.0. Call 602-293-6363.

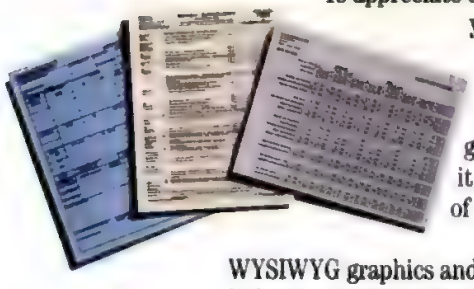
Developers. Artisoft offers a Voice Programmer's Interface so you can create your own "talking" software using the LANtastic Voice Adapter. Order it directly from Artisoft.

ARTISOFT
Revolutionizing Connectivity

*Manufacturer's suggested retail price. Before voice messages can be sent from one PC to another, optional LANtastic Voice Adapters must be installed on both PCs.
**Manufacturer's suggested retail price is $249 for LANtastic 2Mbps adapters and $349 for LANtastic Ethernet Adapters. © 1990 ARTISOFT. LANtastic is a trademark of ARTISOFT.

CIRCLE 254 ON READER SERVICE CARD

WE'D LIKE TO SUGGEST A FEW NEW CRITERIA FOR CHOOSING FORMS SOFTWARE.



To appreciate the benefits of JetForm™ software, we invite you to first examine the subject of business forms themselves. And why every business has so many.

It's because forms are the proven way to gather information. Communicate it. Store it, and process it. Which is precisely the point of view from which JetForm was developed.

Naturally, JetForm gives you complete WYSIWYG graphics and font control, using the industry standard Microsoft® Windows interface.

But we also give you something else. And that's a set of capabilities that turns forms software from a handy way to replace pre-printed forms into a powerful way to run a business.

Which is why you'll find JetForm prints faster on the laser printers that businesses use most.

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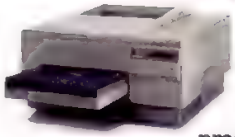
Combined with our optional JetForm-Merge and JetForm-Server software, JetForm makes it possible to completely automate and streamline the entire information management process. From design and forms completion, to printing and integration with your existing dBASE® files.



As years pass, other software makers may discover the true purpose of business forms, and upgrade their products to the capabilities of JetForm. But JetForm has them today. And a new business day starts tomorrow.

Call 800-267-9976 for complete information on the full family of JetForm forms software.

CIRCLE 257 ON READER SERVICE CARD

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CAPACITY

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Call (800) 267-9976 (US only) or (613) 594-3026. Indigo Software Ltd., 560 Rochester Street, Suite 400, Ottawa, Canada K1S 5K2

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Hence, when there is an impending fax transmission or receipt, the memory-resident portion of FAX96 pops up a window and takes over the operation of your computer, restoring your program when the transmission has been completed.

For an added twist, the FAX96 lets you send simply by selecting from the phone directory or by typing in the receiving party's name, company, and phone number. The real surprise is that the FAX96 automatically stores any new information you add to the phone directory. You may select the time and date for transmission; however, the default is the current time and date. Press G for "go" and the FAX96 will send your fax on its way.

If you want to fax a printed document and are fortunate enough to have a scanner, simply select the Page Scan feature instead of choosing a path and a file. The FAX96 will control the scanner and send the scanned image as a fax to your predetermined destination.

INSTALLING THE FAX96

Easiest yet is installing and operating the FAX96. After issuing the command, the computer makes a subdirectory and copies files, prompting you for the required information. The manual contains an excellent diagram for determining where I/O address jumpers go on the half-length board. The software also offers a step-by-step tutorial through sending, receiving, viewing, printing, and scanning faxes.

The only problem we found during installation was that the board contained no markings for the line and phone receptacles. The manual clearly illustrates the correct placement, but who wants to look at the manual for that? The rear bracket panel also contains a manual volume-control dial—not an everyday accessory, but a much-welcome one.

The FAX96's screen simply looks like a normal fax machine panel, with buttons for various functions. You simply press the letter on the keyboard that activates that button's function, just as you would on a fax machine.

Sending faxes is easy with the FAX96.

FAXSIDE PUBLISHING

by Bruce Brown

PC fax boards are useful devices for sending and receiving faxes with your computer, but if you want your outgoing faxes to include more than just text you'll need to do some extra work. People who use standalone fax machines can use letterhead stationery, logos, graphics, charts, photos, signatures, and any other two-dimensional information they can slide into the fax machine. PC fax boards can't accept hard copy input unless you have a desktop scanner attached to your computer.

All is not lost, however, for there are three good solutions to help you dress up your outgoing faxes: two software packages and one good tip. Although each solution uses a different method, Alien Computing's $179 *FAXit for Windows*, Inset Systems' $149 *HiJaak*, and a tip from a past *PC Magazine* column can all help you become a "power faxer."

DUAL-PURPOSE PROGRAM

FAXit for Windows is a dual-purpose program that lets you capture screens from any *Microsoft Windows* application, convert the screens to your fax board's native format, and then control the fax sending and receiving process via the installed fax board.

FAXit for Windows installs as an output device in *Windows* so that when you print a selected file from *Windows*, you can select the *FAXit* device driver. *Windows* thinks it's printing, but what's actually going on is that the output is being converted to either standard-resolution (200 by 100 dpi) or fine-resolution (200 by 200 dpi) fax format files. Because *Windows* applications, by design, are able to incorporate screen elements from each other's programs, *FAXit* lets you use *Windows* as your fax publisher.

> Your PC fax board can't accept hard copy input, but here are three good solutions to help you dress up your outgoing faxes with graphic images.

FAXit for Windows also handles sending and receiving your faxes if you are using one of the fax boards that the program supports. *FAXit* works directly with Intel's Connection CoProcessor and other CAS protocol fax boards, including the PureData PureFax, and with the Xerox/Datacopy Microfax. Other devices currently in testing or development for direct *FAXit* support include the Hayes JT Fax, as well as fax boards by Brooktrout Technology, Panasonic, and The Complete PC.

But even if your fax board isn't on *FAXit*'s currently supported list, you're not left out: you can configure *FAXit* to save the file you want to fax in .PCX, uncompressed TIFF, or .DCX graphics format. The software included with most fax boards can convert and transmit files from one or more of these standard formats.

THE HIJAAK APPROACH

HiJaak is a wonderful graphics capture and conversion utility that can bring text and graphics screen shots into fax documents. *HiJaak* is not a publishing program that you would use to organize components of a document to be faxed. It is a marvelous retrieval and conversion tool for gathering items from various sources to include in your faxes.

HiJaak captures graphics and text screen from most video display modes and can also take HP LaserJet and plotter output files. In addition, *HiJaak* works with HPGL plotter files, *Lotus 1-2-3* .PIC files, and ASCII text files. *HiJaak* converts files to and from the following formats: .CUT (*Dr. Halo*), .GIF (CompuServe), .HPC and .PCL

(continues)

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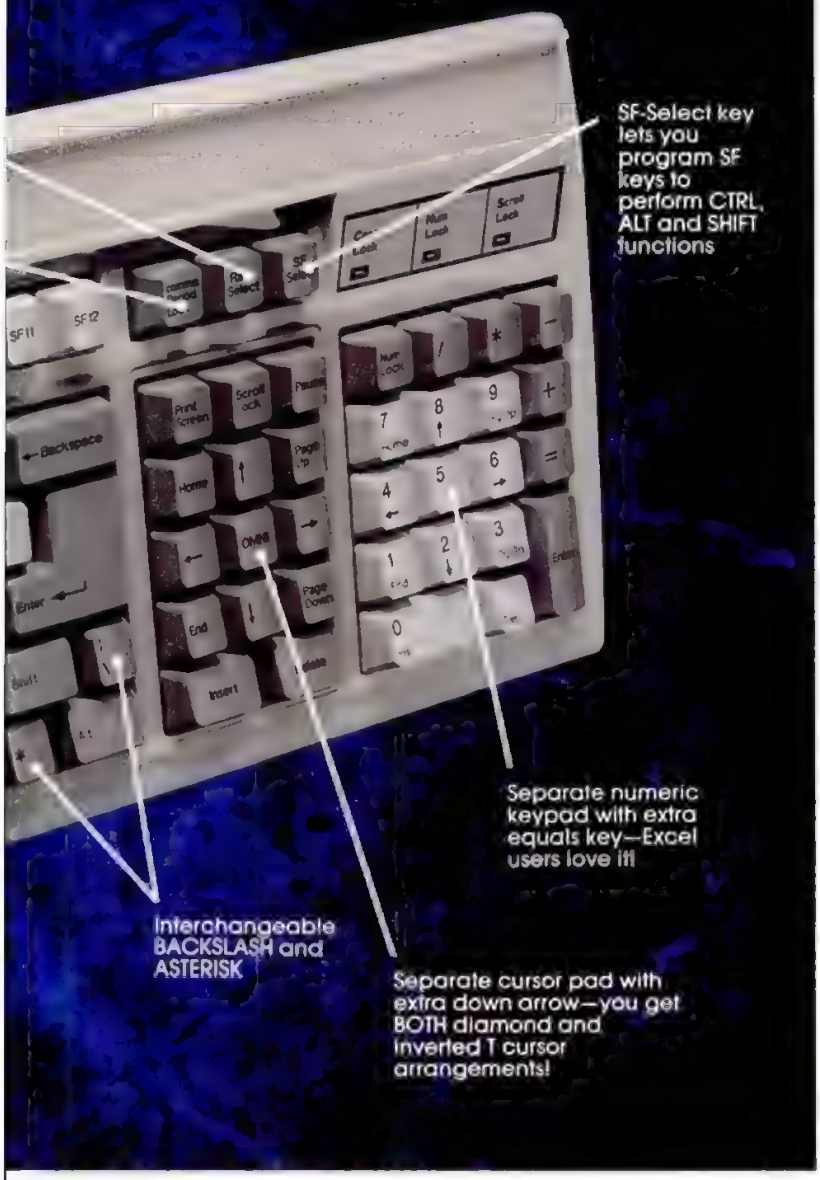
But that's just the beginning. With *OmniKey*/ULTRA, you can even swap Backslash and Asterisk ... it's up to you!

In A Keyboard!



Famous Northgate Functions! Never type U>S>A> when you want to type U.S.A.! Our Period/Comma Lock key locks out < > even when shifted!

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NORTHGATE COMPUTER SYSTEMS *"We hear you!"*

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You complete a cover sheet, stating the recipient's name and what you want to fax. Unlike some PC fax packages, however, sending the cover sheet is optional—another plus for the FAX96. The cover sheet also has ten message lines for remarks or short messages. If your message is that short, you can send just the cover sheet.

The inbound and outbound fax log is straightforward and concise, recording any problems encountered. Viewing faxes is also easy, thanks to a clear and precise screen display. If a fax comes in upside down, a single keystroke rotates it on the screen. You can print each page individually or print the entire file, and print quality on both an Epson MX-100 and HP LaserJet printer is better than average.

For only $50 more you can buy Fremont Communications' 1-LINER, which allows you to use the same phone line for voice and fax communications with an answering machine. If you want to forward faxes to your home-based PC, another $50 will get you FAR-FETCH software. FAR-FETCH lets you retrieve any newly received faxes by using a password; the FAX96 then transmits them to wherever you are.

The FAX96 has a 30-day money-back guarantee and a two-year warranty with excellent technical support. You can call or fax in your problems to Fremont Communications. We even found them returning calls on weekends, a definite plus for the weekend user.

For the money you can't beat the FAX96. It has nearly all the rich-boy features at a price that even a hacker can afford. You have to consider it if you want the most for the best price.

("Faxside Publishing" continued)

(Hewlett-Packard LaserJet), .IFF (Commodore Amiga), .IMG (*GEM Paint*), .MAC (*Macintosh*), .MSP (*Microsoft Paint*), .PCX and .PCC CUT (*PC Paintbrush*), .WPG (*WordPerfect* Graphics), both compressed and uncompressed TIFF formats, and many others. One of *HiJaak*'s most powerful features is its ability to convert text screens to scalable .EPS (Encapsulated PostScript) files.

Once you've retrieved text and graphics from various sources, *HiJaak* can convert directly to the formats used by several fax boards. If you have a file in another fax board's format, *HiJaak* is also useful for converting between fax formats. The list of fax board formats that *HiJaak* currently supports includes those of most major vendors, such as The Complete PC, Intel PCEO, Hayes, Brother, and Ricoh.

A TIP FROM SEYMOUR

If you know someone with a fax machine or have your own machine, you don't even have to purchase other software to set up graphics items for your outgoing faxes via fax board. In his June 27, 1989 column, contributing editor Jim Seymour reveals the easiest way to bring the widest variety of text and graphics output into your fax board's format: have someone fax it to you! Of course, if you have your own fax machine, you can fax it to yourself using separate phone lines.

Anything you've received as a fax you should be able to convert with your fax board's own software to .PCX or some other graphics file format. The next step is to edit the file with *PC Paintbrush* or some other supported graphics paint program to prepare it for outgoing faxes. With this method you could fax yourself your letterhead, a signature block, and any other commonly used graphics element for later incorporation into outgoing faxes.

Each of these three ways to dress up outgoing faxes is a multistep process, so for priority one-time faxes, the effort probably isn't worth it. Certainly none of these solutions is as simple as shoving a piece of paper into a fax machine. All three methods, however, are worth the time it takes to create letterhead, logo, and signature files that you'll store and use many times in outgoing faxes. ■

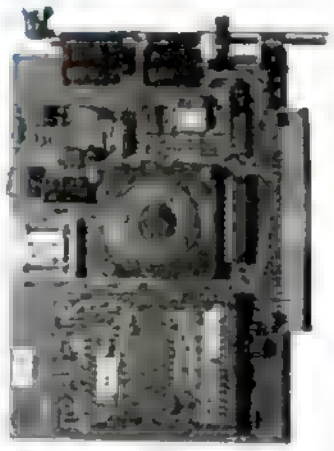
FAXit for Windows
Alien Computing Inc., 37919 50th St. East, Palmdale, CA 93550; (805) 947-1310.
List Price: $179 ($19.95 with purchase of Intel's Connection CoProcessor through August 1990).
CIRCLE 660 ON READER SERVICE CARD

HiJaak
Inset Systems Inc., 71 Commerce Dr., Brookfield, CT 06804; (800) 828-8088, (203) 740-2400.
List Price: $149
CIRCLE 661 ON READER SERVICE CARD

GAMMALINK

GammaFax NA

by Kimberly Maxwell



If you haven't seen GammaLink's product lately, you should check it out: it is not like its ancestors. The latest not-so-frilly GammaFax NA competes well with the heavyweights in its division.

The 9,600-bit-per-second fax package retails for $495. The internal fax board comes equipped with software and documentation to send and receive faxes. GammaLink also offers the GammaFax MC for $795 for those with Micro Channel systems.

The GammaFax NA barely met our cost requirement, but its ease of installation makes it a tough contender. The menu-driven operation and useful on-line help screens easily make up for the higher price.

INSTALLATION GUIDE

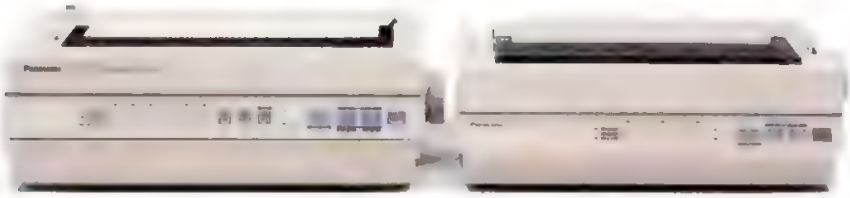
The GammaFax NA's manual has an installation guide oddly located in the back appendix, but because installation is so simple you may never need this section. You just plug in the internal fax card, copy the files to your machine's hard disk, and answer a few questions about your system to complete configuration.

While the board doesn't have a scanner interface, its software comes ready to work with add-in scanner products chosen from a menu. Choices include the Canon IX-12, HP ScanJet, JLaser, and any other scanner supporting .PCX, .CUT, and TIFF files. You can configure your printer in a similar way by selecting from the GammaFax NA's list of compatible printers.

The GammaFax supplies two jacks for telephone wires; these are clearly labeled to differentiate between the line and telephone connections. Also included is a restricted built-in data modem to communi-

Engineered for the office. Designed for people.

Due to space limitations, we can't show you all the awards our 1124 and 1180 printers have won.



What can we say? Of course, we're proud. But we've always been proud of our 1124 and 1180 Dot Matrix Printers—even before they started winning all these awards. Who wouldn't? They just make so much sense. Each one, for example, has multiple paper paths. Load it from the bottom or rear. And put it wherever you want. Each one has an EZ Set™ Panel. As well as a staggering 3400 print combinations possible from a wide variety of fonts, sizes and enhancements. And each one comes with a 2-year limited warranty on parts and labor. (See your dealer for details.)

Panasonic® 1124 and 1180 Dot Matrix Printers. They're everyone else's choice. Shouldn't they be yours, too?

CIRCLE 381 ON READER SERVICE CARD

P3-PC

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Panasonic
Office Automation OA

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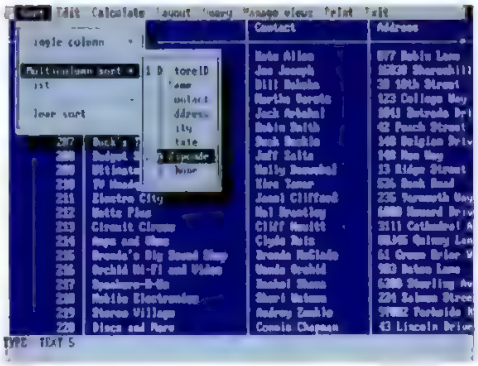
Common Sense Interface. R:BASE 3.0's new pull-down menu interface eliminates the need to memorize a complex set of procedures. Cascading menus, dialog boxes and information lines at the bottom of the screen give you a visual map of where you are, where you've been and where you're going.

Sampler Kit and risk-free offer. Get the R:BASE 3.0 Sampler Kit—just $9.95 if you act before August 1, 1990. For details call **1-800-248-2001, ext. A14.** We're so sure you'll like R:BASE 3.0 it comes with a 90-day money-back guarantee.



R:BASE 3.0 allows you to look at, edit and ask questions of your data from a single menu. Order your columns with a simple check of a box. And work with your data in a spreadsheet-like layout—locking columns and rows, moving or hiding columns, even copying data from one field to another.

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THE DATABASE THAT RUNS ON COMMON SENSE.

CIRCLE 539 ON READER SERVICE CARD

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Microrim Nederland BV, Beukenhorst East Building, Jupiterstraat 210-212, 2132 HJ Hoofddorp, The Netherlands Tel 011-31-25 03 41 190

FACT FILE

GammaFax NA
GammaLink, 133 Caspian Ct., Sunnyvale, CA 94089; (408) 744-1430.
List Price: $495
Requires: 512K RAM, hard disk, DOS 3.0 or later.
In Short: GammaFax NA has an adequate number of easy-to-use features and can send and receive faxes very clearly. A simple menu system, quick installation, and easy operation make this product a good selection.

CIRCLE 650 ON READER SERVICE CARD

cate with other GammaLink fax cards. This nice feature works within your company, but you'll have to purchase another standard data modem to communicate with the rest of the world.

For an additional $440, GammaLink's *GammaScript* allows you to send any size text, graphics, or CADD drawing from your computer using GammaFax software. That's not all: *GammaScript* can recognize and translate output from any application that supports PostScript into fax format. You just save the documents as PostScript files within the application and transmit them through GammaFax or as an attached file to GammaMail messages. Not only will the receiving person see the fax, but the fax will look as if it were printed with a PostScript printer.

The Queue Manager, an 180K TSR program within GammaFax, puts outgoing jobs in a queue, then processes them in the background. When you receive an incoming fax, the Queue Manager finds it and saves it so that you don't have to exit—a plus for those who hate to leave their application to receive a fax. GammaFax beeps once to let you know you have an incoming fax; two beeps signal when a transmission is complete.

SELF-EXPLANATORY MENUS

We liked the self-explanatory GammaFax menus. The main menu list allows you to send and receive faxes and to check for sent, received, and pending faxes. You can create a phone list, send faxes to multiple destinations, or print, scan, and display faxes. The conversion tool lets you reduce the size of a fax, and you can change your system's settings using the setup menu. Each menu selection consists of smaller windows with a variety of options.

The nifty phone book feature stores frequently dialed fax numbers. You can quickly call up your phone book and create a listing, which comes in handy when you want to send the same file to multiple fax machines. You merely tag the individual fax numbers on the phone list and send the fax with or without attached files. GammaFax's expanded activity log supplies such information as the number of seconds a particular transmission took, the message rate, and the number of retries remaining.

GammaLink markets the GammaFax NA as a 9,600-bps fax product, but you can switch to a lower transmission rate for machines located overseas or those having slower transfer speeds. You can lower the transfer rate to 7,200, 4,800, or 2,400 bps through the initial send and receive communications window or within the phone book. You can also delay any transmission to a later time for better phone rates or to establish predated or staggered releases.

The GammaFax NA does have one shortcoming. We found that using conversion tools to reduce the size made a document hard to read on the screen.

GammaLink offers a three-year warranty on its fax card. If you have problems or the board does not perform up to standard, the company will fix or replace it under the warranty. GammaLink also offers free technical support should you have difficulties with the software, hardware installation, or operation.

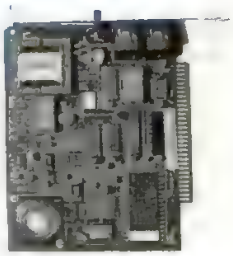
> GammaFax's Queue Manager, an included 180K TSR program, puts outgoing faxes in a queue, then processes them efficiently in the background.

The GammaFax NA is not loaded with a lot of extras, but if you want a simple internal fax product, you won't be dissatisfied. Considering the GammaFax NA's features, you'll find it offers a decent selection of fax capabilities for the price.

HAYES MICROCOMPUTER PRODUCTS INC.

Hayes JT Fax 4800B

by Randol Tigrett



The Hayes JT Fax 4800B represents a mature, time-tested entry in the fax marketplace. Hayes Microcomputer Products bought the JT Fax from Quadram last year, and the newest release adds both greater performance and strong technical support.

The Hayes JT Fax gives you a bargain price, but not by sacrificing its well-written documentation and software. This internal modem slid way under *PC Magazine*'s $500 price limit. At $295—$100 less than it was when we last reviewed it—the JT Fax is a steal.

Its installation kit includes both two 5.25-inch and one 3.5-inch floppy disks. Installation is menu-driven and simply asks for the boot disk and the source and destination drive letters.

The half-length adapter card fits any 8- or 16-bit slot in an AT bus. If you need help, the documentation offers step-by-step installation information in understandable English—a real plus for those of us who hate manuals.

PC Magazine gave JT Fax high praise in its last roundup of fax boards (see "PC to Paper: Fax Grows Up," *PC Magazine*, April 11, 1989), and little has changed except for a lower price tag. The software remains easy to use with consistent menus that bring up overlapping, lower-level menus as you proceed through functions. And the 4,800-bps rate remains unchanged.

ALL-INCLUSIVE MENU

The menu handles everything necessary for normal fax functions, including automatic conversion of graphics files to fax format. Unfortunately, for automatic conversion to Group 3 fax, Hayes chose only *PC Paintbrush*'s .PCX file format for JT Fax to support.

We found no problems when faxing several files consecutively by chaining them together. A group-fax feature lets you send to multiple addresses. JT Fax software recognizes redirected printer output from an application and output from the PrtSc key.

JT Fax's well-behaved TSR waits for DOS to suspend activity before the program takes over your DOS session to send or receive a fax. However, the TSR does have one small operating drawback: you must unload the TSR from memory to change its configuration.

For example, to avoid spending 90 seconds in transmitting the cover sheet, you must unload the TSR and rework its configuration. In its favor, the TSR gives you foreground transmission and reception of fax images.

COMMAND-LINE UTILITIES

Instead of using the JT Fax's TSR, you can insert fax commands with the included command line utilities into any batch file to use from your favorite DOS shell or scheduling software. Hayes command line utilities give you an easy DOS interface.

The FAXL command lets you select time and date of transmission, phone number, and filename. FAXL supports 11 error-level returns that you can use to initiate further batch processing. Other command-line utilities allow printing, displaying, and converting faxes.

The image produced by the JT Fax is superior among the products we reviewed in this roundup. The conversion and transmission time is comparable to that of adapters that transmit at 9,600 bps—no small accomplishment.

Hayes's free technical support, available from 8 A.M. to 6 P.M. Eastern standard time, is one of the best in the business, with an average 7-minute answer and response time.

An added plus is that Hayes supplies a free customer-support BBS and a toll-free number. Hayes allows you to use its BBS for downloading software patches or exchanging ideas.

FACT FILE

Hayes JT Fax 4800B
Hayes Microcomputer Products Inc., 705 Westech Dr., Norcross, GA 30092; (404) 441-1617.
List Price: $295
Requires: 180K RAM, hard disk, DOS 2.1 or later.
In Short: The Hayes JT Fax 4800B is a mature, easy-to-use fax package, and the company's customer support is excellent. The JT Fax 4800B fax modem is as fast as its larger 9600B modem cousins. The price may be bargain-basement, but the product is priceless. With the intuitive menus we at PC LAN Labs give it a thumbs-up.

CIRCLE 651 ON READER SERVICE CARD.

INTEL PCEO

Connection CoProcessor

by Mike Byrd

What a difference a year makes! Intel's Personal Computer Enhancement Operation (PCEO) now offers the improved Connection CoProcessor for $695, which represents a virtual 40 percent drop in price from last year. Even at the board's phenomenally reduced price, Intel added many improvements for easier and simpler operation.

The Connection CoProcessor package contains an on-board 80188 microprocessor and 256K of RAM for true background operation, and either fax or file transfer at up to 9,600 bits per second. While the Connection Coprocessor is transferring faxes, your computer is free for other applications.

Also included is a communications option socket that accepts piggyback options, such as a 2,400-bps modem priced at $195. The option socket saves you a slot when it comes to adding devices.

SOFTWARE FEATURES

The Connection CoProcessor software lets you do more than sending and receiving faxes. You can create and edit graphics files (through *PC Paintbrush*), create multiple phone books of information about people you frequently fax to, and keep records of all your transactions.

In addition, the Connection CoProcessor supports the DCA/Intel Communicating Applications Specification (CAS).

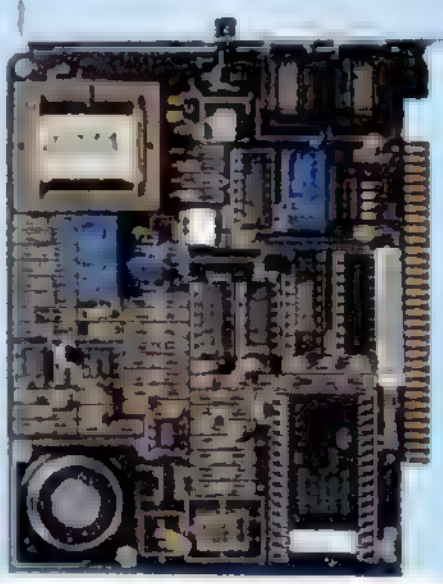
FAX MODEMS: The External Connection

by Frank J. Derfler, Jr.

Sometimes integrating a fax adapter into a PC is just too hard. There are hassles with IRQ addresses; conflicts with other boards, like mouse adapters; limitations on the number of expansion slots; broken fingernails—and sometimes just the fear that if you open the box it will never work right again.

Also, while your laptop PC might not have an expansion slot, you might still need to fax an order back to the office. You also may want to avoid the high price hotels charge to fax a page. But whether you're too timid or tired to open your Pandora's box of a PC—or merely plan to travel—an external fax modem could be just the ticket.

Several companies make external fax modems—devices about the size of a TV remote control that pop on a serial or parallel port and convert the output from your PC into something a receiving fax machine can love. When you finish faxing, you can toss the modem into a briefcase or drawer and regain use of the port.



Some of these products also act as standard data modems, and all come with software that lets you place calls and control fax activities. Reasonably priced, they offer portability and good performance; any one could supply all the fax capability you'll ever need.

At $499, The Complete FAX/Portable, from The Complete PC, is a pocket-sized, battery-operated, 9,600-bit-per-second external fax unit designed for portable, laptop, or desktop personal computers. This unit plugs into a serial port and provides send and receive capability.

The $499 Everex Systems' EF 12/48 is both a fax and a general-purpose 1,200-bps modem compatible with the Hayes command set. It comes with Everex's *BitCom 3* communications software for general communications, as well as with *EFax* 2.0 fax software.

The Hayes JT Fax 4800 Portable doesn't have its own battery or an internal data modem, but its software is the same time-tested friend used on the high-

This specification allows software developers to turn business applications into communications applications.

If you wish, you can send files to someone with another Connection CoProcessor. Neither party needs to know anything about start or stop bits, parity, or any other communications parameter; the software does it all. You just tell it what, where, and when. The Connection CoProcessor does the rest using the V.29 half-duplex 9,600-bps fax modem.

The Connection CoProcessor software also has a RAM-resident module called CONNECT. If you have EMS memory, only 5.5K will reside in RAM; the rest resides in EMS. If you do not have EMS, the background module uses 63K of RAM.

Through CONNECT, you can access all of the Connection CoProcessor's features. It not only schedules your fax transmissions but also lets you create, store, and maintain your telephone lists. Furthermore, CONNECT contains a simple text editor for creating short messages and a full graphics editor that uses *PC Paintbrush* and accepts scanned images of hardcopy documents.

INSTALLATION

Hardware installation is a breeze; your only real option is to select the I/O address for the Connection CoProcessor. If the default address doesn't work after installation, you merely change the DIP switches to another I/O address. The Connection CoProcessor is a full-length board; it even comes with support brackets. The manual gives detailed pictures and explanations on the complete installation process.

Software installation is a three-part process. First the install step creates directories on your hard disk and copies files from the four Connection CoProcessor disks. Registration consists of displaying a product registration "card" on the screen that you complete for later toll-free transmission to Intel.

The setup helps you configure the Connection CoProcessor software to your computer. An optional screen lets experienced users examine or modify some of the more technical settings of the board and software; most setups do not require this optional step. You accomplish the final part of the installation by completing the "walk-through," or step-by-step tutorial, of the software features. It offers a good insight into the operation of the program for those who need it.

STRAIGHTFORWARD OPERATION

We found CONNECT's operation straightforward, with intuitive menus. Our only complaint about the entire package is really about one of its assets: the background send and receive fax operations are so transparent that you don't know if they are really happening or not.

CONNECT acknowledges the receipt of a fax through the foreground by a beep; however, if you are not in the room or have an application package that also beeps, you may not be aware of receiving a fax. The only way to check for new faxes is to go into CONNECT and check the logs, which can delay fax distribution.

The Connection CoProcessor's performance is considerably faster than that of most of the other PC fax cards we tested. The print quality on the Epson and the HP LaserJet printers was very good. All menus and operations performed just as expected. Overall, the Connection CoProcessor is a solid product.

The Connection CoProcessor gives you a warranty of five years, the best of all the fax packages we reviewed. Technical support is equally notable, with a toll-free hotline, Intel-sponsored bulletin board service, and CompuServe. The outstanding

FACT FILE

Connection CoProcessor
Intel PCEO, Mailstop CO3-07, 5200 NE Elam Young Pkwy., Hillsboro, OR 97124-6497; (800) 538-3373
List Price: $695; 2,400-bps modem, $195.
Requires: 640K RAM; hard disk; CGA, EGA, VGA, or Hercules graphics; DOS 3.0 or later. Mouse recommended.
In Short: A solid, well-built, high-performance PC fax card with optional expansion to modem operations. The Connection CoProcessor offers true background operation, superb technical support, and a five-year warranty.

CIRCLE 652 ON READER SERVICE CARD

FACT FILE

The Complete FAX/Portable
The Complete PC, 11893 Concourse Dr., San Jose, CA 95131; (408) 434-0145.
List Price: $499

CIRCLE 655 ON READER SERVICE CARD

dds4000
Digital Data Systems, 30100 Telegraph Rd., Birmingham, MI 48010; (313) 258-1122.
List Price: $2,095

CIRCLE 656 ON READER SERVICE CARD

Everex EF 12/48
Everex Systems Inc., 48431 Milmont Dr., Fremont, CA 94538; (800) 821-0806
List Price: $499

CIRCLE 657 ON READER SERVICE CARD

Hayes JT Fax 4800 Portable
Hayes Microcomputer Products Inc., 705 Westech Dr., Norcross, GA 30092; (404) 441-1617.
List Price: $495

CIRCLE 658 ON READER SERVICE CARD

WorldPort 2496 Fax/Data Modem
Touchbase Systems Inc., 160 Laurel Ave., Northport, NY 11768; (800) 541-0345, (516) 261-0423.
List Price: $699

CIRCLE 659 ON READER SERVICE CARD

ly rated JT Fax internal fax adapter. This software converts text to the fax format and sends the transmission in the same call. The program sends *WordPerfect* 5.0 and any Epson-compatible word-processing file without alteration and lets you edit the received fax images. The package sells for $495.

Touchbase Systems' $699 WorldPort 2496 Fax/Data Modem is both a 2,400-bps standard modem and a 9,600-bps fax modem. An auto-dial, auto-answer data modem, the WorldPort is Hayes Smartmodem 2400 compatible and runs on its own 9-volt battery.

Digital Data Systems has developed a unique external fax device with a completely different use in mind. The dds4000 attaches to a PC's parallel printer port. Special firmware in the dds4000 makes it look like a printer to the host machine. The device takes the printed output of application programs and converts it to fax transmissions on the fly.

DDS aims this product at local area network print servers. The price reflects the usage: $2,995 with special system integration software for Novell's *NetWare*. ■

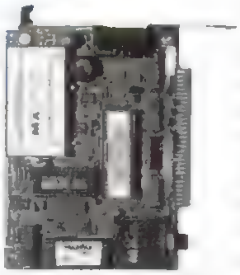
manuals you get with the system contain both background technical information and helpful installation hints.

The Intel PCEO Connection CoProcessor shared an Editor's Choice designation last year and continues to be a solid performer. If you need a true background fax operation and can handle the price, Intel's Connection CoProcessor is the way to go.

MACRONIX INC.

MaxFax 9624

by Mike Byrd



Need both a PC fax card and a Hayes-compatible modem that work with rather than against each other? The MaxFax 9624 from Macronix may be just what you need. For $499, you get a PC fax card operating at up to 9,600 bits per second and a 2,400-bps, Hayes-compatible modem.

One of the MaxFax's unique features is its ability to detect automatically whether an incoming call is from a fax machine or a modem and to handle the call appropriately. This means you don't have to preselect the type of call you expect to receive.

The MaxFax allows background operation, allowing the PC to send and receive faxes while running other applications in the foreground. However, if the foreground application program does a large amount of disk I/O or disables interrupts, it may interfere with fax transmissions; normally this is not a problem. The card contains a Sierra Semiconductor MAC chip using the 8096 instruction set. Total RAM on the chip and board is 304 bytes.

HOTKEY SEQUENCE

Hotkey sequences allow you to capture printer output for subsequent fax transmission, terminate the background program, and switch from voice to fax transmission—all from DOS or any application package.

You can build a phone directory containing all the numbers you need to call, listed either alphabetically or by group. To broadcast a file or a series of files to a group, you need only to specify the group name. The MaxFax automatically schedules those files for transmission at the selected time to all members of the group.

The product maintains an incoming/outgoing message log that you can view on your monitor or send to your printer. You can also check the status of incoming and outgoing faxes, as well as those in the print queue.

MaxFax lets you convert between ASCII, *WordStar*, *WordPerfect*, and *MultiMate* text files—or .PCX (*PC Paintbrush*) files—and fax format. The card operates normally at 9,600 bps but automatically adjusts its speed to 7,200, 4,800, or 2,400 to match the remote fax machine's speed.

The FAX menus are easy to follow and logical; help is available for most context-sensitive menus, but we found two problems. First, neither the manual nor the help menus discuss any limitations on the phone number format. We found, while entering new numbers to the phone directory, that the customary space between the area code and the prefix completely disabled the phone number file.

We observed the other problem during the performance tests: our HP LaserJet printer driver only printed the first 11 inches of pages longer than 11 inches. The complete fax was available in the computer and for display on the monitor; we just couldn't print the entire page. These are small program problems, and Macronix is presently looking at them.

INSTALLATION A SNAP

Hardware installation is a snap with this well-designed half-length card. You select COM1 through 4 by setting a series of three jumpers; the manual's schematic diagram is explicit on where to put the jumpers.

Software installation is almost as easy. The manual steps you through installation, creating a directory and then copying files from the three MaxFax diskettes. Next, the manual leads you through the configuration program with a series of questions, most of which pertain to how you want the MaxFax to operate.

The MaxFax has two software modules: BFAX and FAX. BFAX sends and receives faxes unattended in the background and captures text and graphics files that are printer-ready. BFAX uses 133K of RAM, a significant amount. A simple hotkey sequence, however, removes BFAX from memory.

The FAX module controls the MaxFax package. Through FAX you can send and receive faxes, add to or edit the phone directory, dial out on the modem, change configuration parameters, and view and edit sent and received faxes.

The MaxFax's modem function works quite well. You can use it directly through the MaxFax software or through any of the popular communication packages like *Procomm*, *PC-Talk*, *Crosstalk*, *Carbon Copy*, and *Mirror*. Using *QModem*, we had the MaxFax card parameters installed and running within 30 seconds without any problems. If you have any problems, the MaxFax has a one-year warranty, and technical support is free through a toll-free number.

The MaxFax software and documentation are undergoing rewrites; neither of the new versions were available for review. The planned upgrades should fix any bugs remaining and yield even stronger capability, for the MaxFax is definitely a contender for the dual fax card/modem market.

FACT FILE

MaxFax 9624
Macronix Inc., 1348 Ridder Park Dr., San Jose, CA 95131; (408) 453-8088.
List Price: $499
Requires: 512K RAM; hard disk; CGA, EGA, or Hercules graphics; DOS 3.1 or later.
In Short: You might find the ace you need with this card. The MaxFax 9624 is both a PC fax card and a 2,400-bps Hayes-compatible modem. The MaxFax supports background fax send and receive, automatic broadcast, multiple file transmission, and fax transmission scheduling.

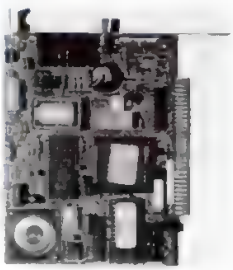
CIRCLE 653 ON READER SERVICE CARD

Editor's note: As this issue went to press, we received word of a price change for this product. It is now $359.

PROMETHEUS PRODUCTS INC.

ProModem 2400BFAX

by Randol Tigrett



With its inexpensive $199 ProModem 2400BFAX, Prometheus Products offers a standard 2,400-bit-per-second data modem with 4,800-bps transmit-only Group 3 fax capabilities. The company also sells a $249 PS/2 version—the best Micro Channel value around.

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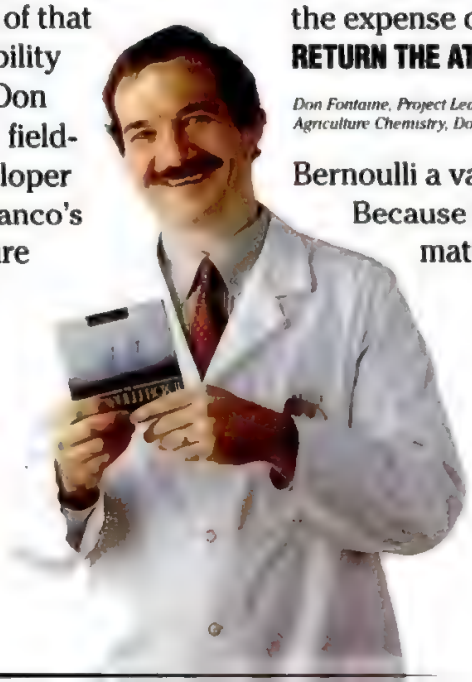

Don Fontaine, Project Leader Agriculture Chemistry, DowElanco

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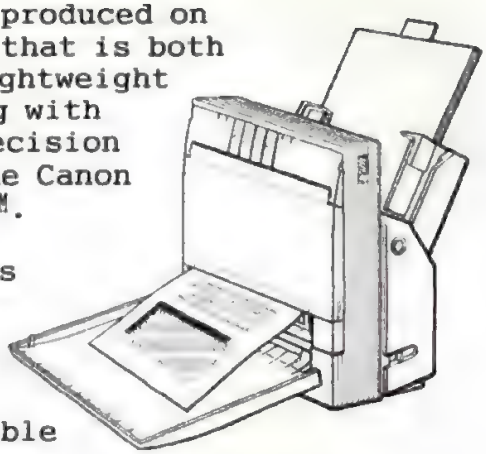
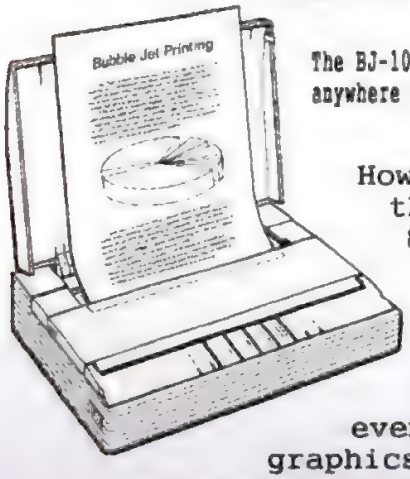
This document was produced on the first printer that is both a desktop and a lightweight portable, printing with letter quality precision on plain paper. The Canon BJ-10e Bubble Jet ™.



The BJ-10e with its optional 30-sheet feeder printing on a desk.

On a desk, with its optional 30-sheet paper feeder, it's an ideal personal printer. As a single-sheet portable with its optional rechargeable battery pack, it weighs a remarkable 4.6 pounds and prints on a variety of paper. The BJ-10e emulates the IBM® Proprinter™ X24E, so you can use a wide range of applications software.



The BJ-10e printing a single sheet anywhere you want.

How fast is it? It printed this page on ordinary 8 1/2"x11" paper at 83 characters per second. It won't slow down when printing in bold or various type sizes either. It even handles complicated graphics, as you see in these scanned-in BJ-10e illustrations.

What's more, its blacks are intensely black and its ink dries instantly, so it never smears.

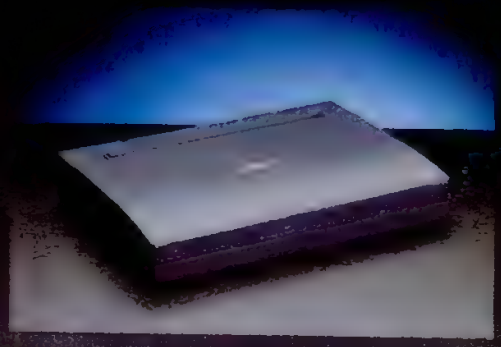
Another page in printer history.

How quiet is it? Quiet enough to be used in the middle of the night with someone asleep a few feet away.

And, you never have to worry about maintenance because it uses a pop-in BJ cartridge which contains the print head and the ink supply. Every cartridge prints approximately 700,000 characters (HQ mode), making it as economical to use as it is to buy.

But best of all, the BJ-10e works everywhere you could possibly need it, fitting neatly into a briefcase with its optional rechargeable battery pack.

The Canon BJ-10e Bubble Jet. What other printers print on a desk, it prints anywhere.



Canon BJ-10e

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ACTUAL SIZE

BUBBLE JET

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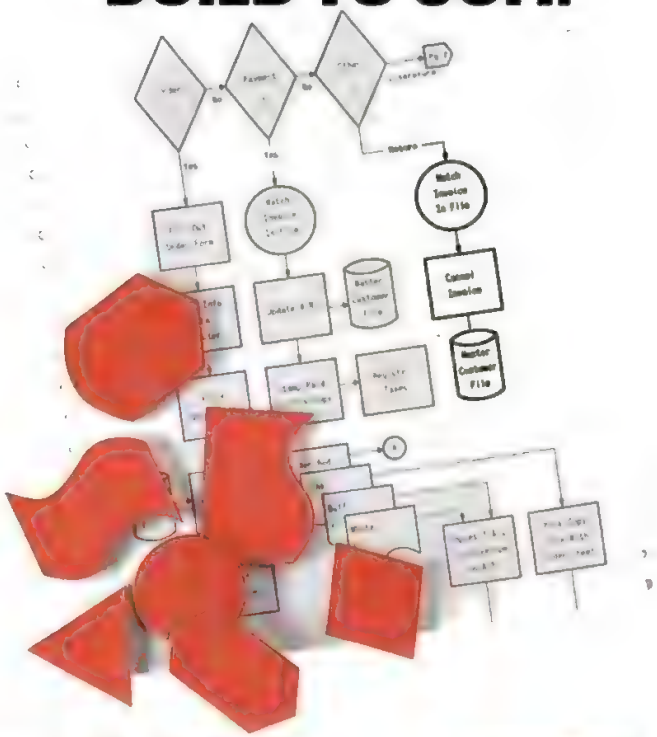
BUILD TO SUIT.



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Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

If you are looking for a laptop fax card and have the Toshiba 1100 Plus, 1200, 1600, 3100e, or 5100, the company sells an internal 2400B modem for $249. Prometheus modem products send but do not receive fax images.

The Prometheus ProModem is a V.22bis data modem using Sierra Semiconductor's application-specific integrated circuit technology. The half-length 8-bit board offers two RJ-11 jacks, both unlabeled, for the phone line and telephone instrument. During installation, you set the board's IRQ address using slide-on jumpers.

FACT FILE

ProModem 2400BFAX
Prometheus Products Inc., 7225 SW Bonita Rd., Tigard, OR 97223; (800) 477-3473, (503) 624-0571.
List Price: $199
Requires: 640K RAM (hard disk recommended), DOS 3.0 or later.
In Short: The Prometheus ProModem 2400BFAX is a inexpensive internal 2,400-bps modem with 4,800-bps fax transmission capabilities. Proven fax software and high-quality communications software add value to the package.

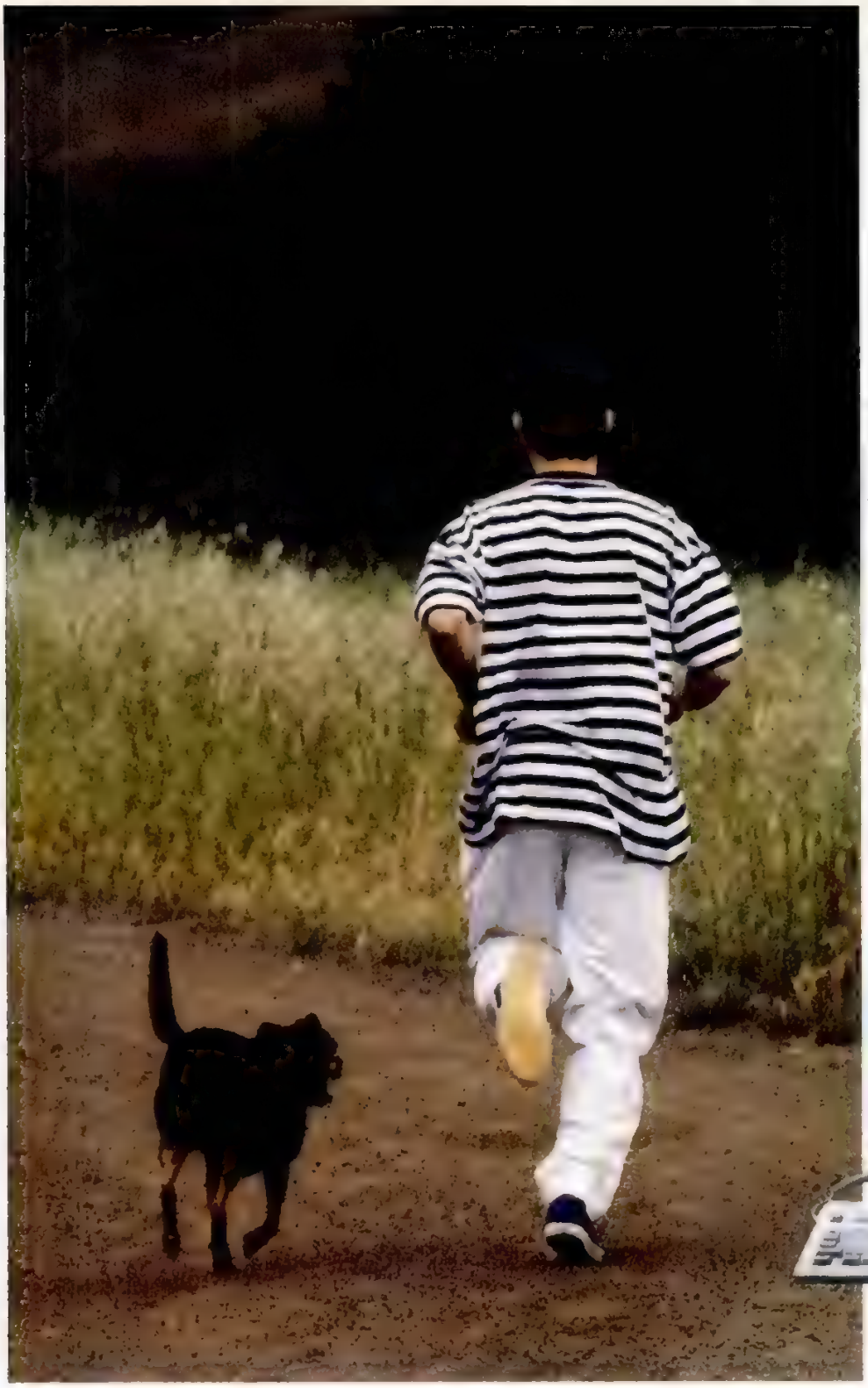
CIRCLE 654 ON READER SERVICE CARD

RESELLS PROGRAM

Prometheus resells the *BitFax* program from Bit Software as its own product, calling it *Fax-it* (no relation to the FAXit product discussed in the sidebar "FAXside Publishing"). We evaluated this software in our review of Cardinal Technologies' SendFax Modem 4800, which gives more information on the product.

As we detailed in the Cardinal review, the *BitFax* software has many features including a telephone directory, fax preview, integration with popular word processors, and creation of cover pages. The hardware and software combination is easy to install, and the transmitted images are excellent.

If you run into a problem, technical support from Prometheus is free. Unfortunately, we were unable to reach them despite many tries. This may well bother you, but keep in mind that the product integrates a standard chip set with proven software. Indeed, the appeal of the ProModem 2400BFAX is its standard modem capability and low price tag. ■



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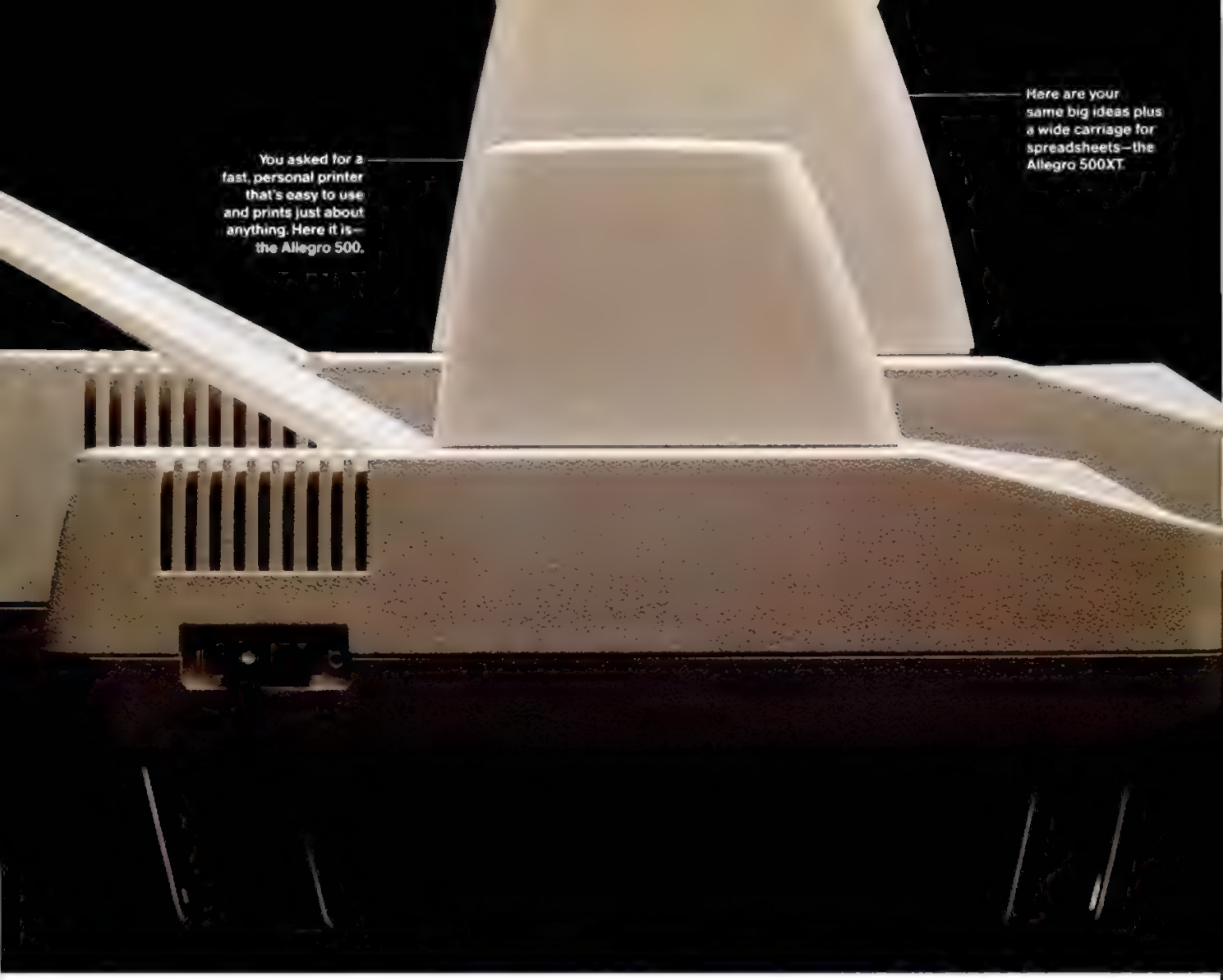

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1-2-3 The Super Solver

You'll have to venture into the world of OS/2 to use Lotus 1-2-3/G, but it may be worth the trip to take advantage of the spreadsheet's remarkable "What-If" feature: the Solver.

by Craig Stinson

You might say that the "what-if" game launched the PC revolution. The ability to change a few numbers at one end of a web and immediately see ramifications at the other end—with no muss, no fuss, and no eraser—was so valuable to business that it made *Lotus 1-2-3* the hottest software product in history.

A spreadsheet's limitation, of course, is that what-if effects ripple through worksheets in the forward direction only—from antecedent to consequent. If you change an input, you get a new output.

What if you want to start with the bottom line and work your way back to the top? The spreadsheet has always been a blunt tool when dealing with that type of problem solving. Mathematically astute users could solve some goal-seeking problems with simultaneous equations and iterative recalculation, but spreadsheets were supposed to be for everybody.

What if you're seeking several conflicting goals? If selling more widgets means selling fewer frommets, with what kind of spreadsheet model will you discover the optimal value of every variable?

Such "optimization" problems are, in many cases, solvable by a technique called linear programming (LP). While it's not a typical spreadsheet component, linear-programming modules are available to spreadsheet users. Borland's *Quattro Pro*, for example, includes a set of LP commands, and for the last five years, *Lotus 1-2-3* users have been able to buy a powerful add-in package called *What's Best*, from General Optimization (Chicago, Ill.).

But both *Quattro Pro* and *What's Best* assume a good deal of user sophistication. *Quattro Pro* tucks its LP module inside the ominously named Advanced Math menu, which includes inviting items such as Objective Function and Extremum. *What's Best*, like *Quattro Pro*, sticks to the linear-programming vocabulary, but at least makes an effort to explain what it's doing. Both *Quattro Pro* and *What's Best*, however, leave the impression that optimization problems are for people with pencils tucked behind their ears.

The first program to bring goal-seeking and optimization down to the level of the common user, and to present it (almost entirely) in plain and simple English, is *Lotus 1-2-3/G*. This new Presentation Manager-based spreadsheet includes two rather remarkable utilities, Backsolver and the Solver. These two utilities are natural and accessible extensions to the power and versatility of spreadsheet software.

Backsolver solves simple goal-seeking problems. You place a target value in a target cell and indicate which antecedent cell it may vary, and Backsolver plugs in the appropriate value. The Solver is an optimization tool that does much more. If you've got OS/2, a fast 386 machine, and at least 5MB RAM (although 8MB would be a safer bet), *1-2-3/G* is worth a look. If you don't, the software's advantages may not be worth the hardware upgrade. It's unfortunate *1-2-3/G* wasn't initially developed for *Microsoft Windows*. And what a shame it runs so slowly—about half as fast as Lotus's *1-2-3*, Release 3 (see the benchmark results in First Looks, *PC Magazine*, June 12, 1990).

Figure 1: A simple growth model based on four assumptions.

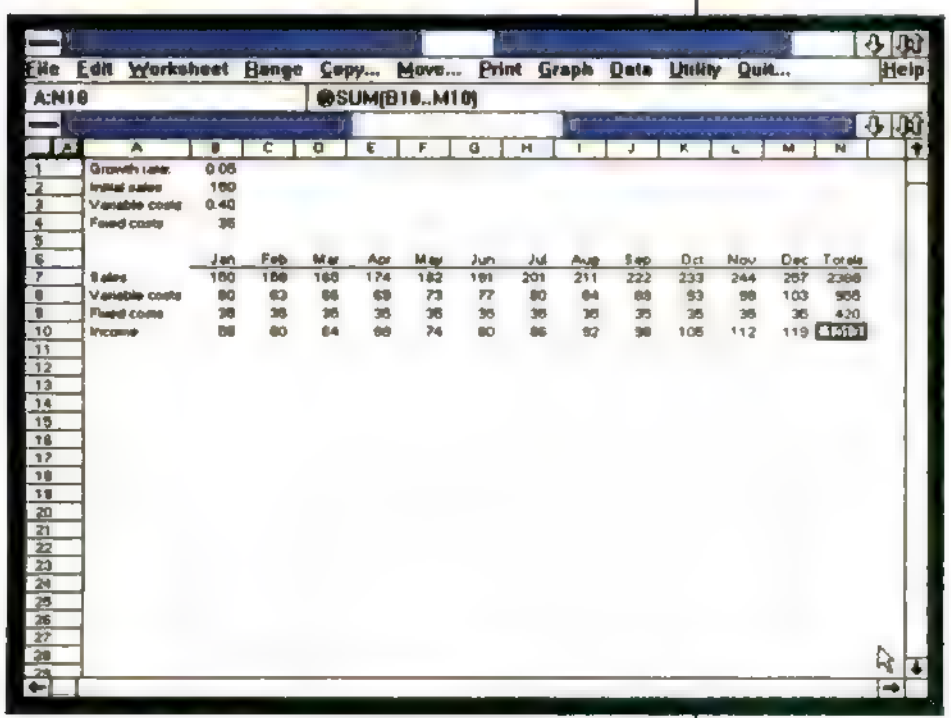
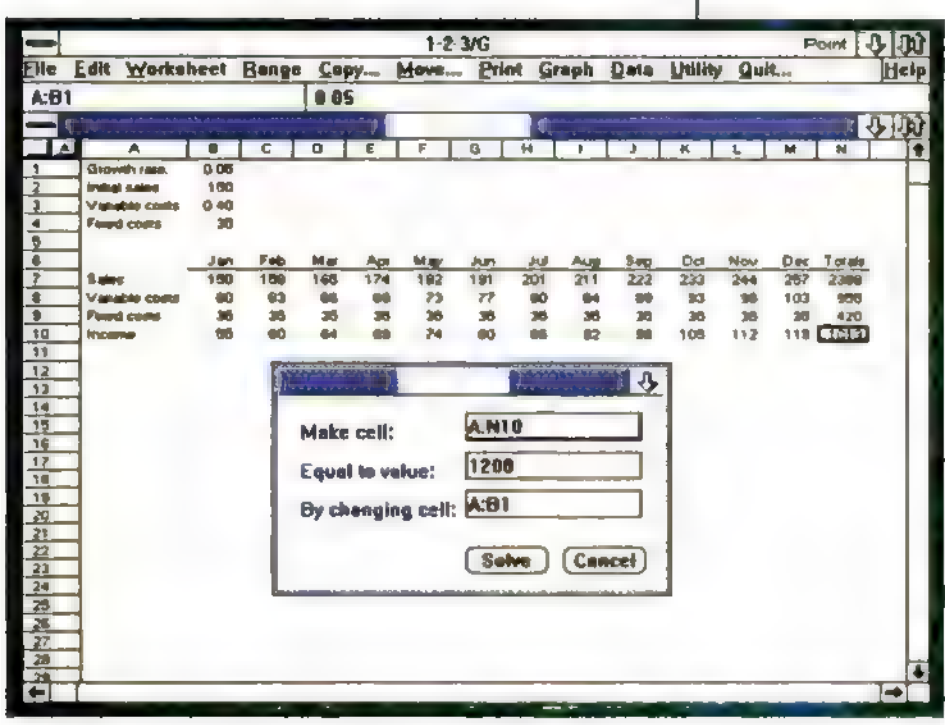


Figure 2: In this example, Backsolver is asked to make the year-end total income equal to $1,200 by modifying the growth rate assumption.



REVERSING WHAT-IF WITH BACKSOLVER

An example of Backsolver's power is illustrated in the growth model in Figure 1. The model is founded on four assumptions: a monthly growth rate of five percent, initial sales of $150,000, variable costs at 40 percent of sales, and fixed costs of $35,000 per month. These assumptions produce a year-end income of $1.013 million. To reach a target of $1.2 million, you could increase the growth rate or the initial sales figure, or you could decrease either of the other two assumptions. Backsolver can tell you what numbers would do the trick.

To use Backsolver, you pull down the Utility menu and click on Backsolver. *1-2-3/G* presents the dialog box shown in Figure 2. The language of this dialog box is simple; it asks you to make cell *x* (N10 in the example) equal to value *y* by changing cell *z*. If you can read English, you can use Backsolver.

In the figure, Backsolver gives the growth rate that would be required to produce a year-end income of $1.2 million. On a Compaq Deskpro 386/25, the program takes a little more than 7 seconds to give us the answer: about 7.1 percent. If Backsolver had been asked to solve for initial sales, variable costs, or fixed costs, the answer would have appeared in less than 2 seconds.

The speed difference results from an initial nonlinear problem, followed by linear problems. That is, if we made a table showing the year-end income that would result from a variety of different growth rates, and then plotted the table as an *XY* graph, the result would be a curve of ever-increasing slope. To do the same with initial sales, variable costs, or fixed costs, a straight line would result. The nonlinear problem is more complex, but Backsolver handles it easily.

Backsolver presents one minor inconvenience: it writes its answer directly into your worksheet, modifying whatever you had there before. If you don't want to plug in Backsolver's solution, you'll need to use the /Worksheet Undo command after Backsolver is finished.

FINDING OPTIMAL VALUES

To get an idea of what the Solver will do, imagine that you're in charge of Widgets Unlimited, a manufacturing facility that produces five types of widgets. Each member of your product line uses the same eight raw materials, but the quantities vary from model to model. The unit profit for your five models ranges from $150 (Model A) to $240 (Model E).

To keep the example simple, consider these two limitations: your inventory of raw materials and your desire to maintain a reasonably balanced product line. If it weren't for the latter, you might opt to produce nothing but Model E, but, for a variety of reasons, you need to ensure that each model constitutes at least ten percent of your product line.

Naturally, your objective is to maximize profits without violating the foregoing constraints. Figure 3 shows how you might begin organizing this problem for the Solver. The table in A6..G14 presents the raw material requirements for each product and the amount of each material on hand. The unit profit figures appear in row 18. Row 24 lists the number of units you plan to produce, and cell B26 displays the bottom line. At the moment, the values in row 24 are all zero, but we could put any values we want in those cells prior to activating the Solver.

As you can see from the formula displayed on *1-2-3/G*'s control line, the total profit is calculated with the help of an @SUMPRODUCT function. The formula multiplies B19 by B24, C19 by C24, and so on through F19 and F24. Then it adds the five products together. Similar @SUMPRODUCT formulas are used in column H to calculate the number of each raw material used.

Before the Solver can solve, it needs to know your constraints. They are listed in cells D30 through D42, as shown in Figure 4. Our model has 13 constraints: each raw material must not be used in excess of the supply on hand, and each model must contribute at least ten percent to the total number of widgets produced.

Each constraint is expressed as a simple logical formula. For example, the formula for the first constraint—the amount of Material 1 used can be no more than the amount of Material 1 on hand—is written

```
+H7<=G7
```

H7 stands for the amount of Material 1 used, G7 represents the amount that is on hand, and the <= (less than or equal to) operator is equivalent to "not more than." The other constraint formulas are similar.

Logical formulas in all versions of *1-2-3* return the value 1 if the formula is true, or zero if it's false. The constraint formulas in D30..D42 are all true at the moment, because we've set up our model with dummy production values of zero in cells B24 through F24.

The fact that all constraints are satisfied with zero values indicates that you can live within your material means and maintain a balanced product line by making, indeed, no widgets at all. The Solver will find this solution, along with all others that meet the constraints. But in a real-world situation, additional constraints—such as minimum labor or plant utilization—would rule out the zero case.

To find the product mix that maximizes profit without violating constraints, we start by pulling down the Utility menu and choosing Solver. The Solver looks like a simple dialog box with four blank fields to fill, but it's actually a separate program thread—in effect, a separate application. While it's busy working, you can minimize it and go back to *1-2-3/G*. You can't modify the worksheet that Solver is using, but you're free to work with any others. While Solver is busy calculating in the background, you can switch back to it at any time to check up on its progress.

Figure 3: **The material requirements, profit per unit, and number of units produced for each of five widget models.**

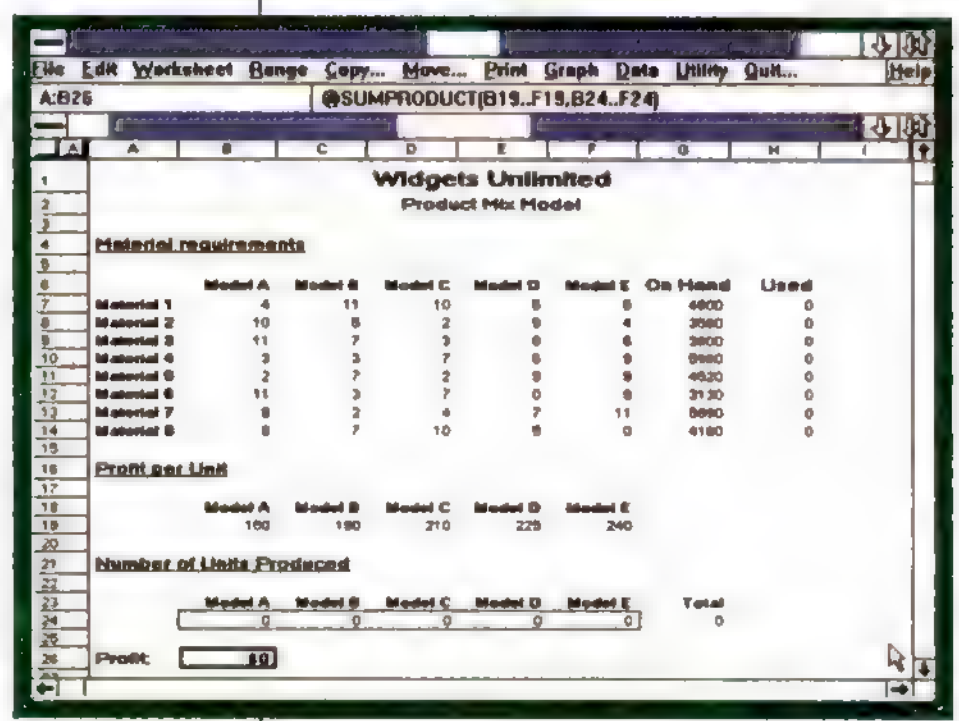


Figure 4: **The constraint formulas in D30..D42 ensure a balanced product line that stays within the limits of raw material resources.**

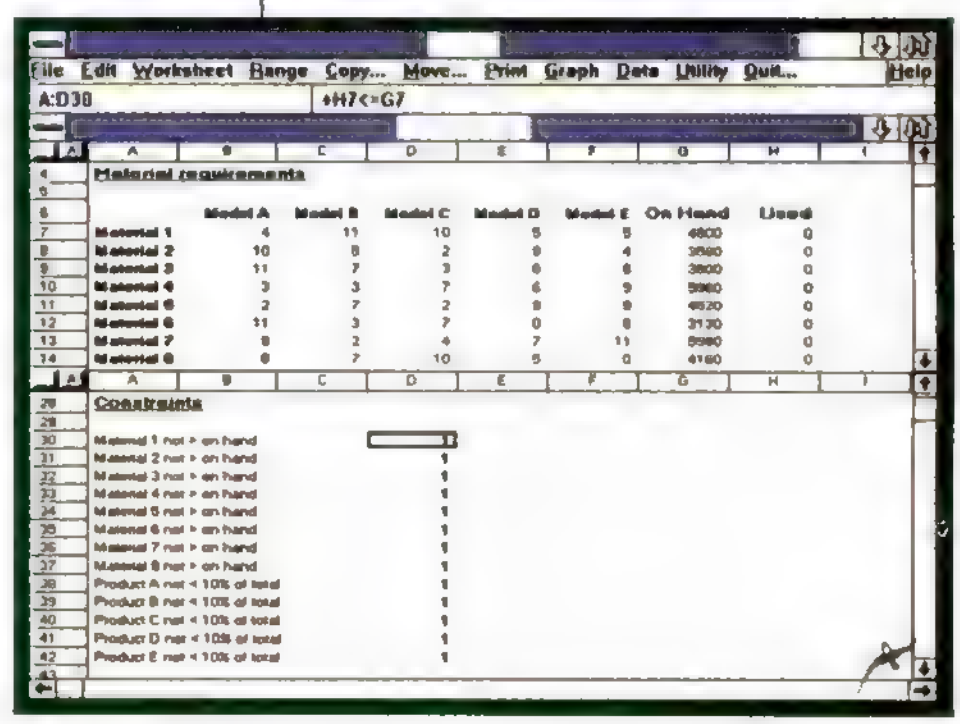


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Figure 5 shows how to fill out the Solver fields for your product-mix problem. On the Adjustable cells line, we tell Solver which cells it can modify. On the Constraint cells line, the range that contains your constraint formulas is supplied. And in the Optimal cell box, you tell Solver just what it is you're trying to accomplish—the maximization of the value at B26.

The adjustables and constraints can be single cells, ranges, or "collections" (groups of ranges). For the sake of clarity, you'll probably want to keep everything within a single worksheet, but that's not required. You can specify cells and ranges in up to 16 different worksheets, provided the worksheets are all open on your desktop.

The optimal cell is optional. If you include it, you also need to tell the Solver whether you want to maximize or minimize its value. Whether you fill out the optimal cell box or leave it blank, the Solver is capable of finding *all* the combinations of your adjustable cells that satisfy all of your constraint formulas.

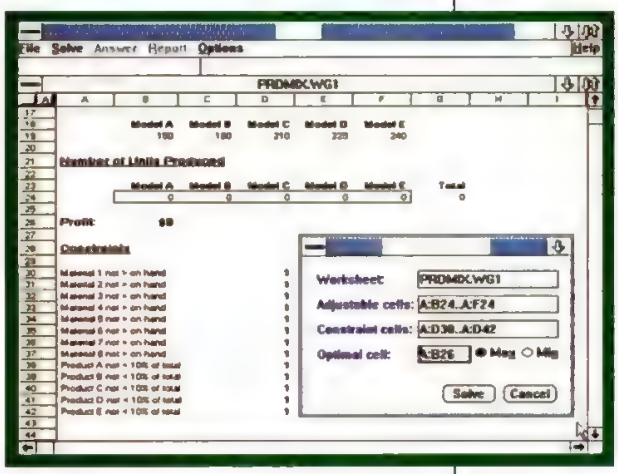

Figure 5: **In the Solver definition window, you specify adjustable cells, constraint cells, and (optionally) a cell to maximize or minimize.**

FINDING THE SOLUTIONS

To put the Solver to work, click on the Solve button or press the F9 key. Solver's Definition window changes to a Progress window in which the program displays a running report on the number of solutions it has found, the amount of time it has spent on the problem, and the (estimated) percentage of the total problem it has conquered.

In our example, Solver stops after a little more than two minutes (on a Deskpro 386/25), having arrived at ten solutions, including the optimal solution. The Progress window changes to an Answer window. When the Optimal button is clicked in the Answer window, Solver plugs the optimal solution into our worksheet. As Figure 6 shows, the best answer is to make 62 Models *A*s, 62 Model *B*s, 229 Model *C*s, 189 Model *D*s, and 82 Model *E*s.

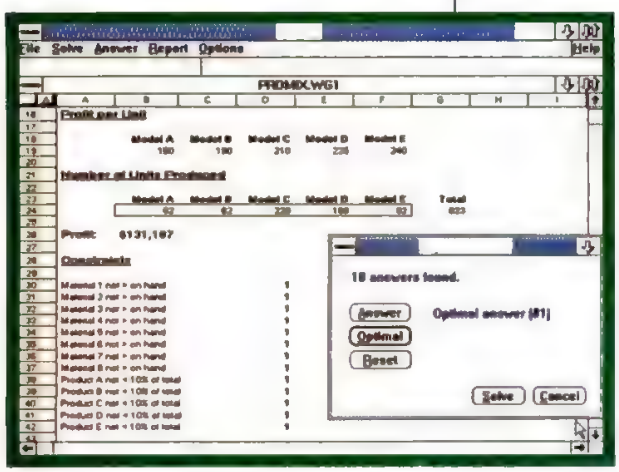

Figure 6: **At a click on the Optimal button, Solver writes the best available solution into the worksheet.**

At this point, you can see the other nine solutions the Solver has found by clicking the Answer button repeatedly. (The Solver sorts its answers so that answer number 2 provides the second-best profit, and so on.) Or, by clicking Reset, the numbers that were in the worksheet before the Solver was activated are restored.

The Solver can go back to work and find more answers, and as long as the Solve button isn't gray, more solutions are available. (By default, the Solver presents answers in groups of ten, but you can configure the setup any way you want. If you're concerned only with the optimal outcome, you can ask the Solver to find only one solution.) In our example problem, the Solver can dig up a total of 28 different, acceptable product mixes.

Why would you care to see 27 suboptimal solutions? In our product-mix model, you might find it worthwhile to compare only the four or five best possibilities. But many resource-allocation decisions are based on factors more difficult to quantify than simple profit or cost. For problems such as these, the Solver's multisolution capability can be a significant benefit. For example, suppose you have a certain number of dollars to spend on a magazine advertising campaign and you need to decide how many ads to place, and where to place them. In each of the publications, your ad reaches a certain number of read-

FACT FILE

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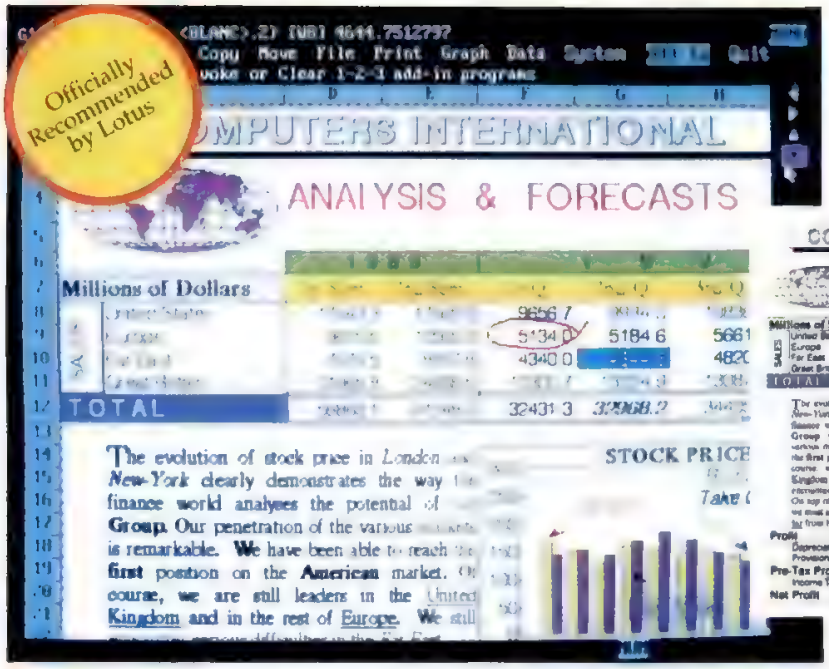

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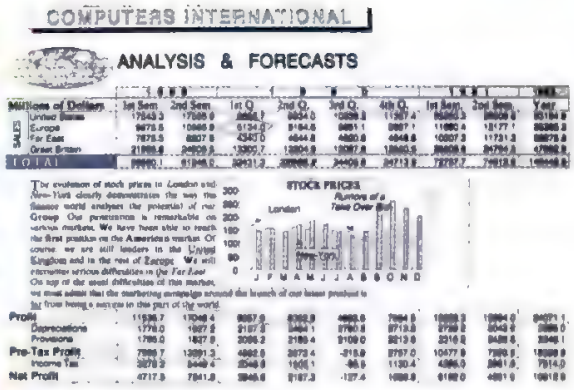

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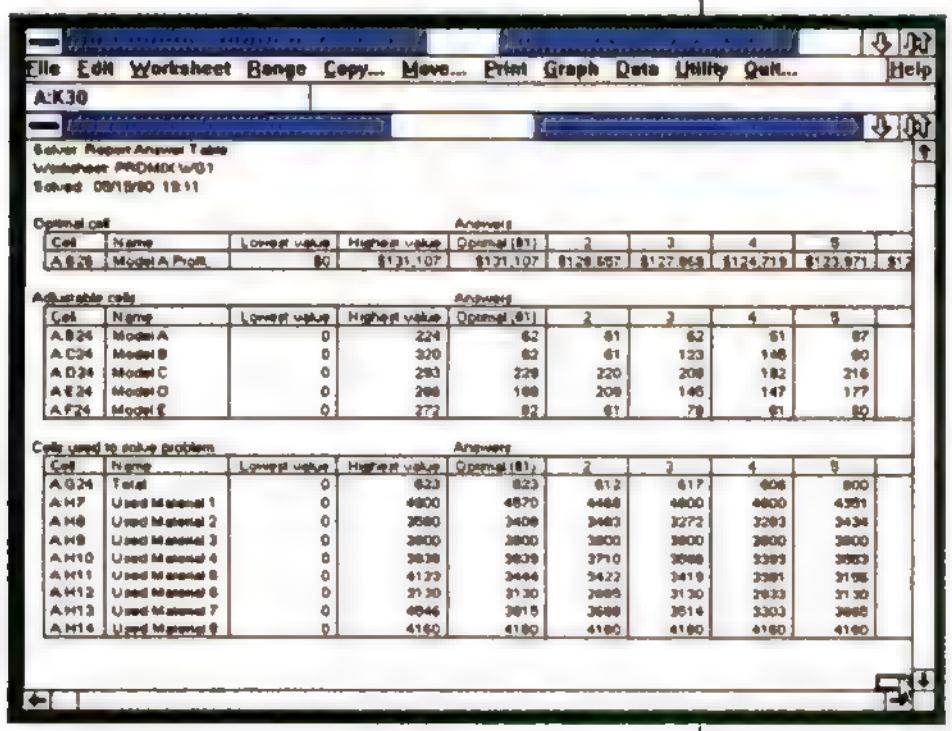
ers for a certain price, but the costs and benefits are not strictly quantifiable because of subject factors concerning the prestige of the various magazines, your assessment of the match between your product and the magazines' readerships, and so on. In a situation like this, you might leave the Optimal line in the Solver's Decision window blank and just ask the Solver to present all the possibilities.

Once the Solver has completed its arithmetic duties, you can use commands on its Report menu to display and analyze its findings. Each of the Solver's several reports can be written to a separate worksheet file, which you can print and save.

The most comprehensive report is the Answer table, shown in Figure 7. It displays names and addresses for the optimal cell and each of the adjustable and constraint cells. Then it indicates the lowest and highest values found for the optimal and adjustable cells, followed by the results of each solution the Solver found. (Only the first five solutions can be seen in Figure 7; the table extends far to the right of the window.) Furthermore, because the results for each solution are displayed in adjacent cells, the Answer table can easily be used for graphing or statistical analysis.

***Figure 7*: The Answer table displays the values for the optimal cell and each adjustable cell for every solution the Solver has found.**



It should be noted that the cell names listed in the second column of the Answer table are derived automatically from labels in adjacent cells. It's a good idea to assign range names to the key components of an optimization model, but even without them, the Solver can generate an intelligible report.

Other reporting options include

- A list of the cells used to arrive at each solution. This can help you diagnose a faulty statement of your problem.
- A report of differences between any two solutions. This can be particularly useful when you haven't provided the Solver with a cell to optimize.
- A report describing how each solution was attained, including a list of which constraints proved to be binding (pushed to their limits) and which did not.
- A separate list of the nonbinding constraints for each solution. This report can help you discover irrelevant constraints.
- A "What-If Limits" report that indicates the range limits in which each adjustable cell can be modified without violating constraints. This information is useful when Solver returns nonintegral values for adjustable cells and you need to know whether certain cells can be rounded in one direction or the other.
- A report on any "inconsistent constraints"—one that causes a problem to become logically unsolvable. Inconsistent constraints can result from a faulty statement of the problem or from unrealistic expectations. Either way, the Solver's report can help you pinpoint the trouble.

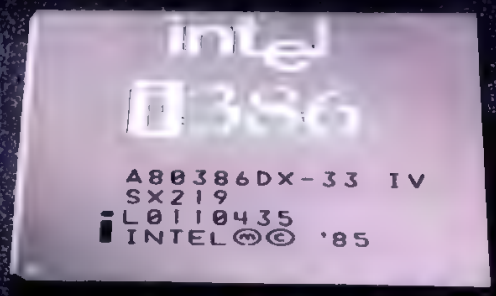
A FEW CAVEATS

With all its power and versatility, the Solver isn't perfect. Some error messages (and their accompanying help screens) are unclear. And, in the current version, the program does not include a command to restrict adjustable cell values to whole numbers, so for many real-world problems you will need to round off the results. (You can add constraints to force integer results, but doing so increases the Solver's processing time and pushes it closer to the limits of RAM and virtual memory.)

Moreover, in some cases, the information presented in the Inconsistent Constraint report may be misleading. When a problem is not solvable, the Solver works for a while and generates a small number of "attempts." For each of these false solutions, the Inconsistent Constraint report will show you which constraint formulas remain false and what values need to be added to or subtracted from each formula to turn falsehood into truth. But the adjustment values reported do not necessarily tell you what you need to do to make your problem solvable. They only tell you what you need to do to make the particular attempt consistent with all your constraint formulas.

These complaints notwithstanding, the Solver is a monumental accomplishment. Without violating the simplicity and accessibility of the spreadsheet genre, it adds tremendous utility for anyone who juggles resources to satisfy potentially conflicting constraints. If only it ran under *Windows*. . . . ■

Craig Stinson is a contributing editor of PC Magazine.



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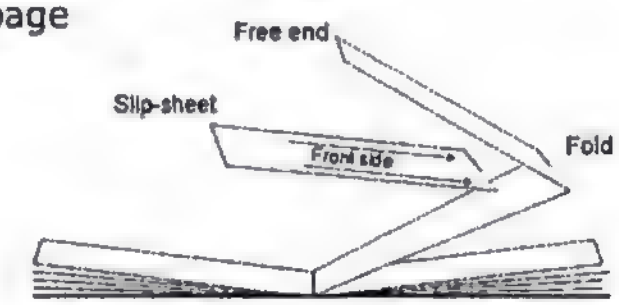

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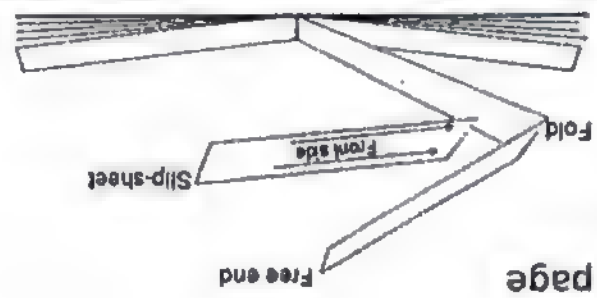

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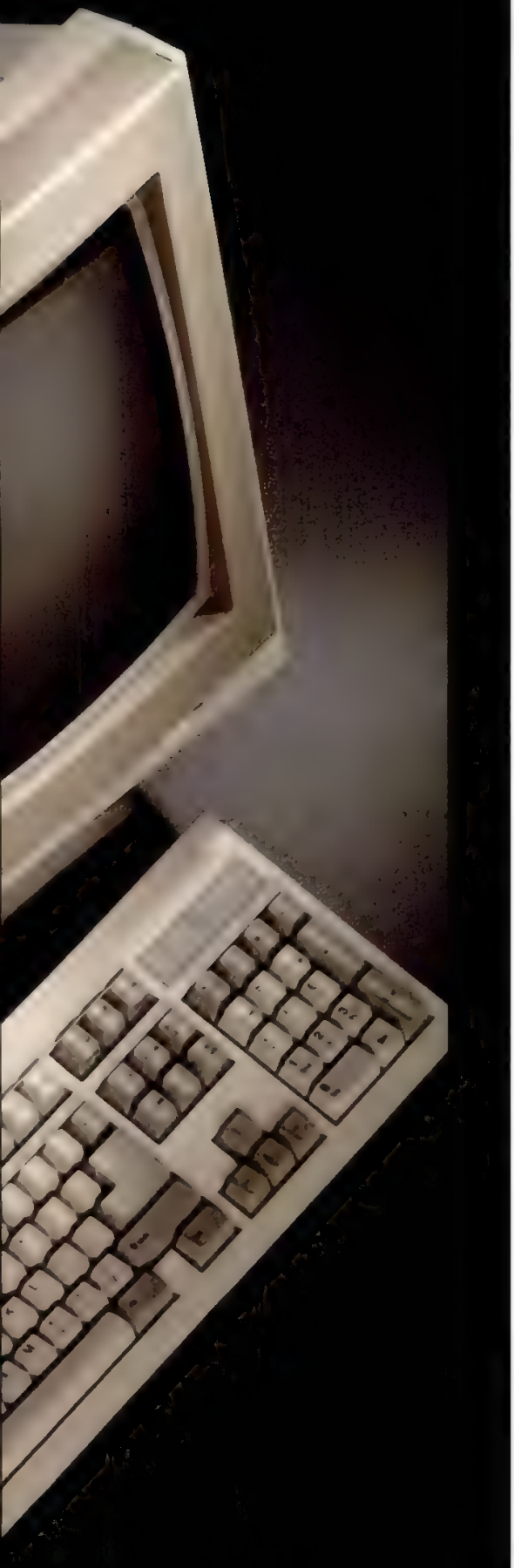
Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side



ZEOS '386

ZEOS® 386

ZEOS® builds the best '386 systems. Compare if you will. But there is no comparison. Because every ZEOS '386 is loaded with power and features the others just can't touch.

For instance, each and every ZEOS '386DX system has a *minimum of a 64K SRAM Cache standard;* our 33MHz screamer comes standard with 128K Cache. Having an on board memory Cache is important in realizing the full potential of any '386 processor. That's why only low end '386DX systems are sold without a Cache. That's also why ZEOS gives you a Cache, and all the extra performance that comes with it!

Sim

the E

MEMORY, WINDOWS™ & DRIVES.

How about memory. Today's more powerful software is increasingly memory hungry. That's why each of the ZEOS '386 packages shown here comes standard with 4 full Megabytes of memory. And this is high speed Zero-Wait state memory too. With 4 Megabytes of high speed memory, the future is now!

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Like our ultra fast 80MB disk drives. Your new system will include an incredibly fast 80MB IDE hard drive. These babies were designed for the '386. And they come packing all the speed you'll need. Now that's ZEOS Value!

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10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editors Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS...is the best value we've come across...its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6

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At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7

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Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8

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In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9

Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Reason #10

You're Going to be Very Satisfied.

When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value*. We don't just say it, *we Guarantee it!*

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a. Your Personal Information

Requested Line of Credit $ _____

Your Name _____ First Initial Last **Date of Birth** _____ Mo. Day Yr.

Present Address _____ Street Apt. # City State Zip

Social Security Number _____ ( ) Home Phone

Date of Residence _____ Month Year **Monthly Payment** $ _____ ☐ Buy ☐ Rent ☐ Other

Previous Address _____

Dates of Residence _____ From To

Your Employer _____
(If self-employed, see rear panel.)

Date of Employment _____ Mo Yr **Position** _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

Previous Employer _____ **Address** _____

Dates of Employment _____ From To

Other Income _____ I have received since (Date) _____
Income from alimony, child support or separate maintenance payments need not be disclosed if you do not wish to have it considered as a basis for repaying this obligation

Monthly Income _____ Gross $ Net $

Name and Address of Nearest Relative Not Living With You _____

Relationship _____

b. Credit Information

Include joint information, if joint account requested

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Account _____ Bank Name ☐ Checking ☐ Savings

Address _____

Bank Loan Reference _____ Bank Name Address

Payment _____ Balance _____

Bank Card Reference _____ Bank Name Address

☐ VISA ☐ Mastercard Payment _____ Balance _____

(please check appropriate box):

☐ **Joint Credit** with another person. Complete all information.
☐ **Individual Credit** but rely on income or assets of another person as a basis for repaying the credit requested. Complete all information
☐ **Individual Credit** Complete sections "a" and "b" only.

Please complete all appropriate sections, *providing at least two years' residence and employment history.* This will enable your information to be processed as quickly as possible. If you are self-employed, please be sure to complete section "d" below.

Other Credit Card Reference _____ Bank Name Address

Payment _____ Balance _____

Other Credit References _____ Payment _____ Balance _____

Account No. _____ Expires _____

Driver's License No. _____ State _____ Expires _____

c. Joint Personal Information

Joint Name _____ First Initial Last

Date of Birth _____ Mo. Day Yr. **Social Security Number** _____

Address _____ Street Apt #

City State Zip

Date of Residence _____ Mo. Yr. **Home Phone** ( )

Employer _____

Date of Employment _____ Mo Yr **Position** _____

Monthly Income _____ Gross $ Net $

Employer's Address _____ Street

City State Zip ( ) Business Phone

d. Self-Employed Information

Complete this section only if you are self employed.

Business Name _____

Business Address _____

☐ Proprietorship ☐ Corporation ☐ Partnership **Business Phone** ( )

Description of Business _____

Your Position _____ **In Business Since** _____

Your annual income from business _____ **Business' annual income** _____ (gross) (net)

You must provide at least one of the following:

1. Business Bank _____

( ) Telephone Personal Banker's Name

2. Accountant's Name _____

( ) Telephone

3. Financial statement on business attached.

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LAN TIMES READERS CHOICE 1990

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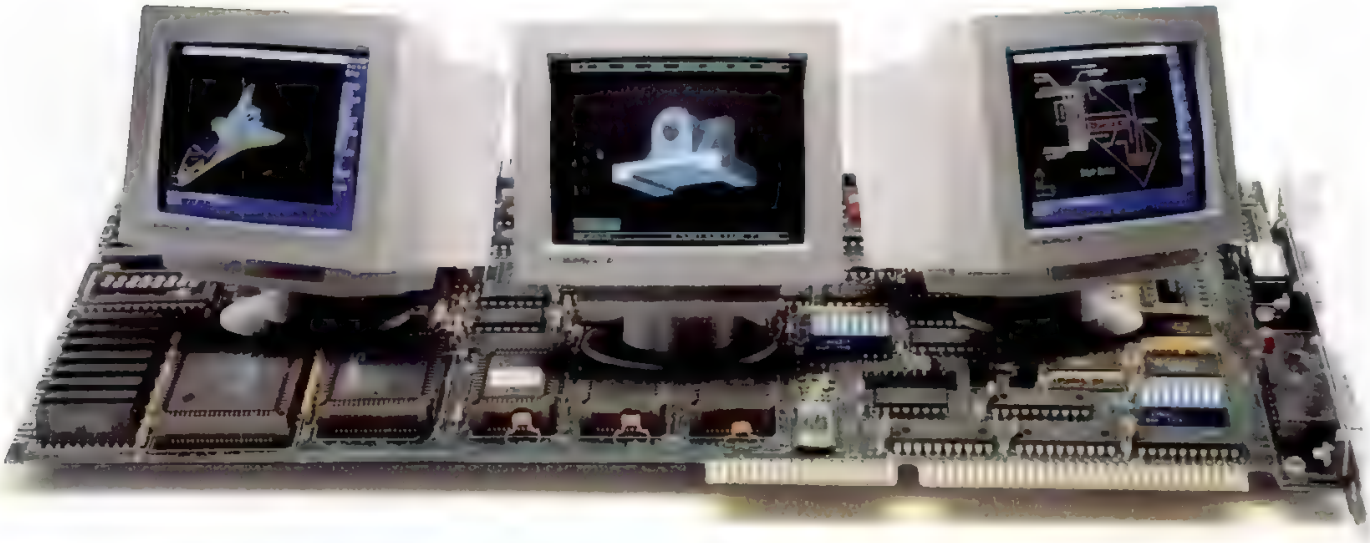
CIRCLE 281 ON READER SERVICE CARD



BUILDING WORKGROUP SOLUTIONS

MULTIUSER GRAPHICS TERMINALS

BY PAUL FERRILL

Using a network of 386-based PCs for multiuser graphics applications has always been costly; now it may be unnecessary as well. These three multiuser terminals link with a single host CPU and run even VGA graphics—with speed you never got from serial communications.

PHOTOGRAPHY: THOM O'CONNOR

Nearly everywhere you turn these days, somebody is offering a "multi" solution to whatever computing problem you face. If you want to give two or more people simultaneous access to the same data, you need a multiuser system or a local area network, which is multinode. Should you need to do more than one task at a time—say, check for e-mail messages while you're computing your stock losses in a *Lotus 1-2-3* spreadsheet—then you need to have multitasking capability.

Until recently, however, a LAN was the only way to make high-resolution graphics available in a multistation workgroup. Many organizations, including architectural firms, government agencies, and security guard forces have needed a big checkbook to set up a LAN with individual PCs equipped to run color graphics applications such as computer-aided design (CAD) systems or graphics image databases. The price for a network of 386-based PCs with VGA graphics and the services of a LAN runs a minimum of $3,000 per node, plus the cost of another PC acting as a server.

Things have changed. New technologies give termi-

nals on shared-CPU systems the ability to display affordable VGA-level graphics without the need for a LAN. In this review we evaluate three systems—from Advance Micro Research, SunRiver Corp., and Viewport Technology Inc.—that put color EGA and/or VGA graphics terminals on multiple desktops.

On a per-node basis, these systems cost between $1,200 and $2,600, less than half the price of a PC-based LAN with similar capabilities.

THE MINICOMPUTER MODEL

Traditionally, multiuser/shared-processor systems haven't been the answer for workgroup CAD and similar applications. These systems follow the minicomputer model of sharing a single CPU under the control of a multiuser operating system among several desktop terminals. The desktop terminals don't run programs or store data locally; everything happens in the single shared computer.

Multiuser systems with shared processors are surely less expensive than a full PC-based LAN.

But the slow communications link (usually RS-232C) between the host and typical terminals limits the ability to show color graphics on the terminals. It takes, for example, a transmission of 16K of data to create a simple CGA screen. At the usual serial terminal with a transmission speed of 19.2 kilobits per second, it would take nearly 7 seconds to paint a single CGA screen.

A PC LAN, in other words, was clearly the best choice regardless of the higher cost. Since a LAN connects a PC's storage to a central file server, each client PC shares access to the server's data and program files but can still run applications locally using its own CPU.

A LAN's biggest advantage is its ability to use PCs already owned by an organization. Its biggest drawback is the need to pay for local computing capabilities on each desktop. Other disadvantages of LANs include the threat of data theft—from users' copying it to a local drive—the loss of data on local PCs that aren't backed up, and the complexity of installing LAN adapters in slot-starved PCs.

Today's multiuser systems allows users to share a single CPU economically. They provide excellent security for data, offer centralized backup and management, and generally are easy to install. Over the last few months, the PC LAN Labs crew installed several versions of Unix and other multitasking operating systems. The job was certainly no more complex than creating a *NetWare, VINES,* or *LAN Manager* server. In fact, it often proved much easier.

A single CPU, however, can do only so much. A PC with a 33-MHz 80386 processor can reasonably support four heavy-duty graphics users. (One of these users, if you're using one of the SunRiver or AMR products, can be the host PC itself, acting as a terminal.) If you add any more graphics terminals, the system response time begins to plummet. Of course, the PC can carry a greater load if some stations don't run graphics.

TWO BASIC APPROACHES

This review covers two basic types of systems. The first high-performance color graphics terminal on the market—one that uses a unique technology—comes from SunRiver Corp. Its stations use a *bus-extension* architecture that extends the PC data bus from the host computer to the local workstation. Linking host and workstation is a fiber-optic cable operating at 32 megabits per second. The I/O circuit components themselves reside on the desktop, and signals pass to the shared CPU over the high-speed link.

The second approach, favored by AMR and Viewport Technology, uses special integrated circuits to extend the keyboard, video, parallel, and serial port cables far beyond their normal limits. This *long-cable* architecture combines all the graphics, keyboard, and serial ports of the workstation into circuits contained on an adapter card in the host PC. The integrated signals then go out over a multiconductor copper cable to a small station controller box, one at each desktop, with connections for a keyboard, monitor, and serial port.

One advantage of the fiber-optic technology is that the workstations can be up to 1,000 feet from the host. Other advantages of fiber-optic cable include its small size, immunity to radio-frequency (RF) interference from fluorescent lights or AC wiring, and high data-rate capability.

Its disadvantages include its minimum bend radius (usually about 1 inch), and its somewhat greater fragility and higher cost than coaxial cable. A 100-foot fiber-optic cable costs $199 versus $147 for a 13-twisted-pair cable. At 250 feet, the costs are $369 for fiber-optic and $282 for the twisted pair.

The cables used for long-cable systems—about the diameter of a parallel printer cable—may seem cumbersome for weaving around the nooks and crannies of your office. This type of cable is also not totally immune to interference, so plan carefully before you run it beside motors, relays, or RF-producing devices. The maximum length of cable is 250 feet for the Viewport system and 100 feet (500 for Hercules monochrome) for the AMR's. That may limit how far you can place your workstations.

WHICH MULTIUSER OS?

When choosing a multiuser graphics terminal, a deciding factor is which multiuser operating system is to be used with it. As the features table shows, not every terminal can be used with every multiuser system.

And the choice of an operating system depends on which applications you want. If you want to run multiple copies of *Microsoft Excel* under *Windows* or use some other application that people in your organization already know, you'll choose one of the multiuser DOS operating sys-

EDITOR'S CHOICE

- **AMR Video Graphics Network Adapter**

You won't make a mistake selecting any of the three multiuser terminal systems reviewed. They all install easily and deliver excellent graphics on multiple workstations.

It's easy, however, to award the Editor's Choice to the AMR Video Graphics Network Adapter. The system furnishes excellent VGA-quality video with fast response and low cost. The VGNA hardware isn't compatible with every possible operating system, but you'll still have good operating system software choices, including both DOS- and Unix-compatible products.

If you must run cables between the terminal and host systems that are over a hundred feet or so, it may pay to consider the SunRiver workstations instead. SunRiver makes sophisticated, high-quality products, but its prices limit the appeal of its products to those who have specific requirements to meet or who want the flexibility to mix SunRiver's video adapters.

MULTIUSER GRAPHICS TERMINALS: SUMMARY OF FEATURES

Products listed in ascending price order

	Viewport Technology VPT System 2000	Advanced Micro Research Video Graphics Network Adapter	SunRiver Corp. SunRiver Fiber Optic Station
List price (two-workstation configuration excluding cable)	$1,799 plus appropriate monitors and keyboards	$1,820 plus appropriate monitors and keyboards	$5,497, includes monitors and keyboards
GENERAL INFORMATION			
Users supported per host adapter	2	2	4
Maximum cable length (feet)	250	300	1,000
Maximum number of terminals	8	8	Limited only by OS
HARDWARE			
Video types supported:			
VGA	❑	■	■
EGA	■	■	■
Hercules monochrome	■	■	■
Bus architectures supported:			
8-bit ISA	❑	❑	❑
16-bit ISA	■	■	■
MCA	❑	❑	■
EISA	❑	❑	❑
Serial ports per terminal	2	1	2
Parallel ports per terminal	0	0	1
COMPATIBLE OPERATING SYSTEMS			
PC-MOS/386	■	■	■
VM/386 MultiUser	■	■	■
Concurrent DOS 386	■	❑	■
386/Multiware	❑	❑	■
Quick Connect/386	■	❑	■
THEOS DOS	■	■	■
SCO Xenix/Unix	■	■	■
Unix System V	■	■	■
386/ix	❑	■	■

★—Editors Choice ■—Yes ❑—No

tems instead of something totally different like Unix (see "Building Workgroup Solutions: DOS and the Multiuser Operating System," *PC Magazine*, September 12, 1989).

Another option in running DOS-based programs, however, is to choose a system that allows your favorite application to run under Unix: *VP/ix*, from Interactive Systems, is one that does (see "An Alliance of Convenience: DOS Under Unix," *PC Magazine*, April 11, 1989).

Finally, you might not care what program or what operating system you use as long as the total system has the functions you need.

TERMINAL PERFORMANCE

For our performance tests, we ran each hardware system on a Dell 386/25 with Intelligent Graphics Corp.'s *VM/386* operating system. We chose the *VM/386* operating simply because it has drivers for all the hardware platforms. It's worth noting that the different hardware products will perform very differently with other operating systems.

We can, however, make some generalizations. Overall, even the heaviest *AutoCAD* shop will be happy with a four-node system running on a single 386 PC. None of these systems, objectively, gave quite the throughput of a single user on the 386 machine running under DOS. But outside of the tests, our team was hard-pressed to tell the difference. The only point we really noticed a slowdown was when more than one terminal used the host's hard disk drive at the same time. Slowdowns due to disk I/O are common to all multiuser systems—even LANs and mainframes.

Color graphics terminals teamed with multiuser operating systems offer economy, ease of installation, small size, and security. If you are an architect, interior designer, realtor, or security agent, there are CAD, design and visual database programs available to meet the needs of your organization on multiuser systems.

Your system choices come down to the kind of job you need to accomplish. If you have a small team of heavy graphics users and you want to equip them with the most economical yet workable system, the long-cable architecture may be just what you are looking for. If, however, you have an environment that needs the distance or noise immunity of a fiber-optic cable, then SunRiver's bus-extension architecture may be preferable.

ADVANCE MICRO RESEARCH

AMR Video Graphics Network Adapter

Advance Micro Research markets both Hercules and VGA graphics models to cover the low and high end of the multiuser terminal market. You can add two more monochrome workstations for around $800 per node, depending on which monitor and keyboard you choose. A VGA setup will run you about $1,500 per node, again depending on the type of monitor you choose. An EGA version of the system is expected this summer.

In AMR's design, both the mono-

FACT FILE
EDITOR'S CHOICE

AMR Video Graphics Network Adapter
Advance Micro Research, Three Lagoon Dr., Redwood City, CA 94065-1562; (415) 594-9991.
List Price: Video Graphics Network Adapter (VGNA) for VGA workstation (includes interface unit with serial connector), $1,195. VGNA User Upgrade (daughterboard), $625. Video Network Adapter (VNA) for monochrome graphics workstation (includes interface unit and provides expansion capability for three additional modules), $599.
Requires: 386-based host PC, compatible multiuser operating system. Per workstation: one VGA or monochrome monitor, AT-compatible keyboard, serial port connector.
In Short: A cost-effective way to add graphics terminals with excellent capabilities to a multiuser system. AMR's monochrome and VGA products offer low-cost and high-resolution color graphics for both DOS and Unix users.

CIRCLE 386 ON READER SERVICE CARD

PERFORMANCE TESTS: MULTIUSER TERMINALS

PC LABS

Multiuser graphics terminal systems sharing a common CPU have slower visual displays than you would expect from a dedicated 386 PC. The AMR system, however, demonstrated performance not far from that of a dedicated PC—at a much lower cost.

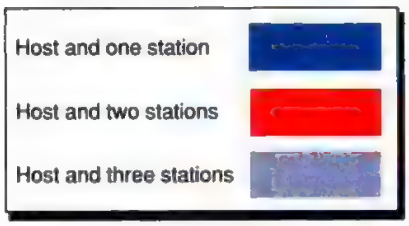
The **BitBlt Alignment** test uses the *Windows* function BitBlt (bit-block transfer) to move a square block of pixels rapidly from one location to another. We are reporting the results for BitBlts configured as 256 by 256 pixels, using the Source Not Aligned and Destination Not Aligned options for these tests (a worst-case scenario). In this case, *alignment* means that the bits describing each row of the bitmap begin on an 8-bit boundary—the start of a byte.

The **Random Rectangles** test draws randomly sized rectangles in random colors.

The **Dialog Boxes (Show and Destroy)** test generates and erases a *Windows* dialog box 20 times.

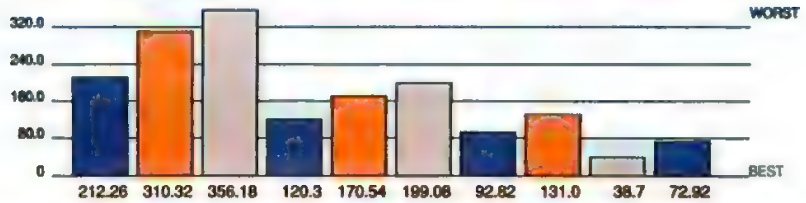
The **Scroll Window** test scrolls aligned and unaligned text vertically through a rectangular window.

The **Rectangular Clipping (Lines)** test for *Windows* creates four separate, equal, rectangular windows on-screen with space in between them. A full-screen image composed of solid lines is then clipped to the windows.

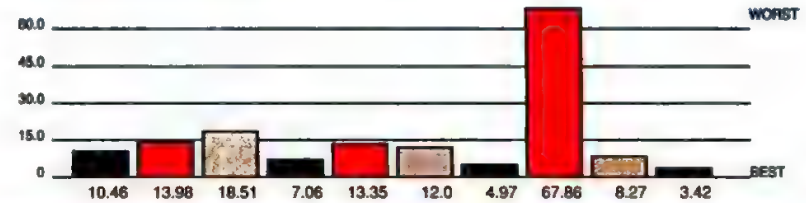


GRAPHICS PERFORMANCE TESTS FOR MICROSOFT WINDOWS

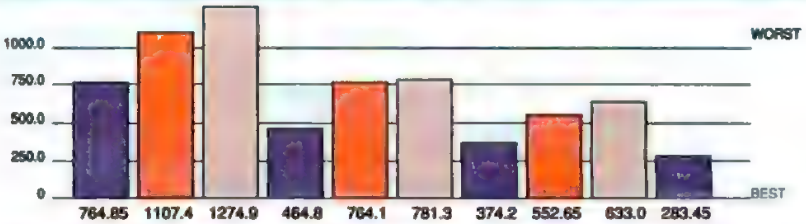
BitBlt Alignment — Elapsed Time (milliseconds)



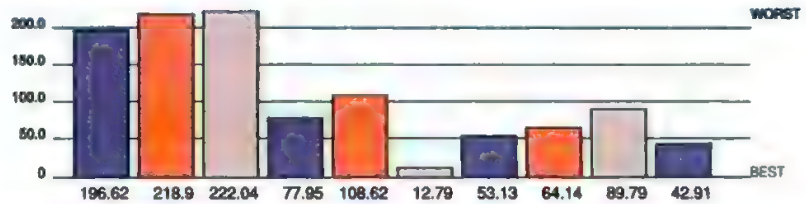
Random Rectangles — Elapsed Time (milliseconds)



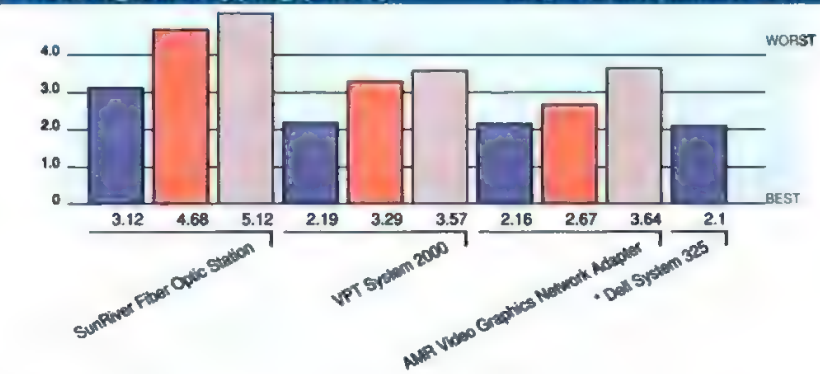
Dialog Boxes (Show and Destroy) — Elapsed Time (milliseconds)



Scroll Window — Elapsed Time (milliseconds)



Rectangular Clipping (Lines) — Elapsed Time (milliseconds)



* Reported for comparison.

CONTINUES

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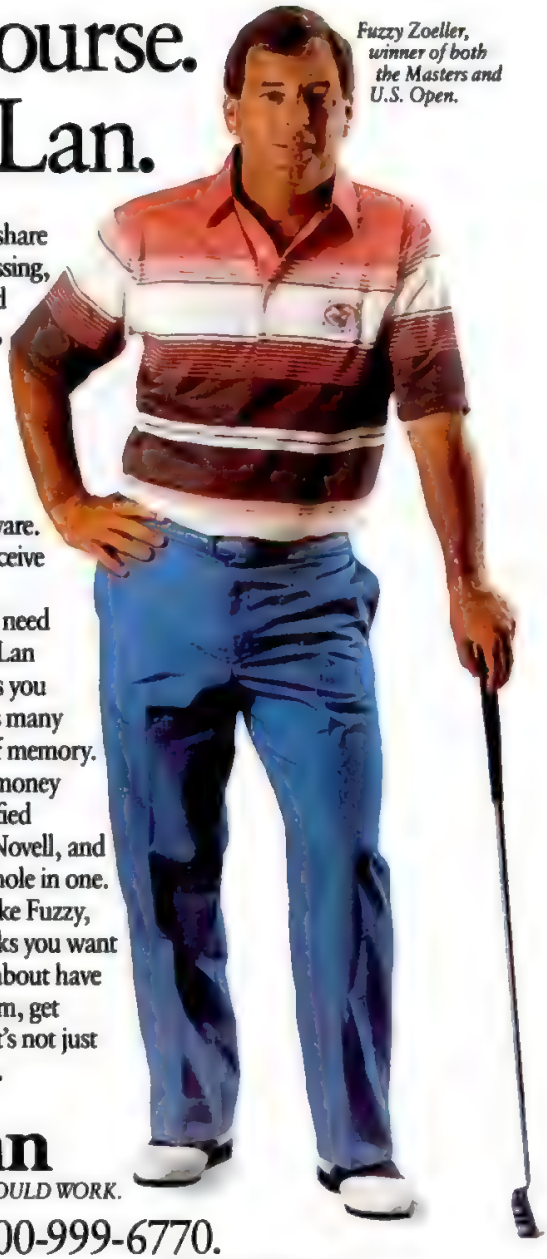

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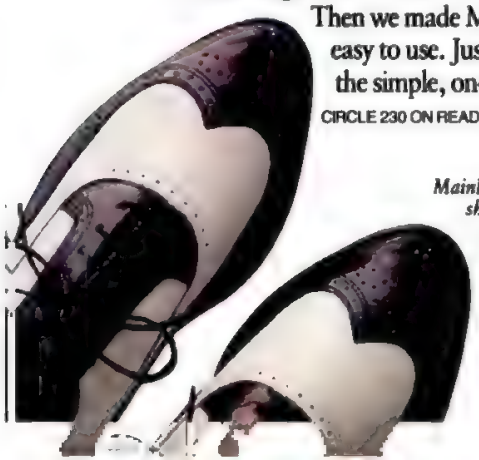

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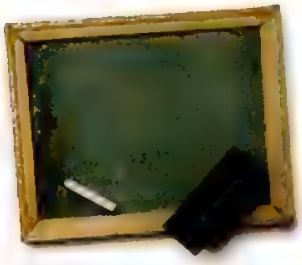

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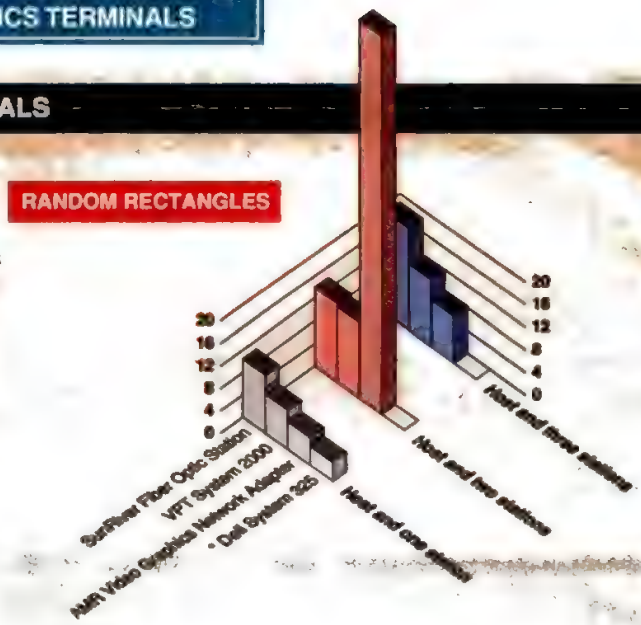
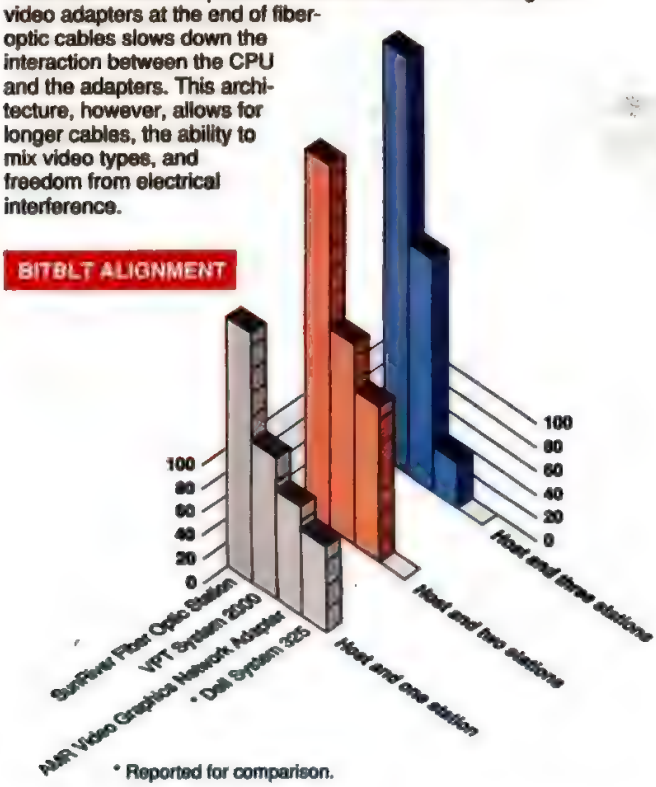
COMPOSITE VIEW: MULTIUSER TERMINALS

PC LABS

Of the three companies' products tested, Advanced Micro Research's VGNA performed very well and will probably carry a heavier load than the other systems, though at the cost of using up more expansion slots in the host. Placing the video adapter components in the system bus, as do the AMR and Viewport products, provides a fast path between the CPU and adapter. The downside is that it forces the use of shorter and thicker cables between the adapter and monitor.

The slow performance of the SunRiver system on PC Labs' tests results from the product's own architecture. Placing the video adapters at the end of fiber-optic cables slows down the interaction between the CPU and the adapters. This architecture, however, allows for longer cables, the ability to mix video types, and freedom from electrical interference.





* Reported for comparison.

We ran the *PC Magazine* Graphics Performance Tests for *Microsoft Windows* on a Dell System 325 computer under IGC's VM/386 multiuser operating system for DOS applications. We used VM/386 simply because this operating system includes drivers for all three hardware architectures.

We first ran our tests on the Dell 325 host with a board installed and one graphics terminal alone, with no activity on the other terminals. As a comparison, we also show the performance times measured running the Dell PC alone under DOS with a Video Seven EGA adapter. This reflects the performance you would experience running this same powerful hardware as a PC client station on a LAN.

Following the single station test run, we activated a second station and then a third to measure the effects of an increased load on performance. In each case the performance of only one station was timed.

Note that these tests focus on the performance of the graphics subsystem alone. They don't show other differences between LANs and multiuser systems caused by contention for disk drives, time-slicing the CPU, and contention for access to the LAN cabling.

Each hardware product offers a choice of several multiuser operating systems for DOS applications and some version of Xenix/Unix. All of these hardware and software combinations will have cost, installation, and performance differences as well.

chrome and VGA host adapters use a mother/daughterboard set that goes into the host 80386 machine. The host adapter contains the chip sets—standard Intel and Western Digital devices—that drive the video and keyboard signals for a single workstation.

To add a second workstation, plug a daughterboard into the host adapter. Each host adapter has two connectors that send the signals for the monitor, keyboard, and serial port over a ⅜-inch multiconductor cable to the terminals.

THE WORKSTATION

Each desktop workstation consists of a standard AT keyboard and appropriate monitor (neither of which is supplied), plus a small box measuring approximately 3 by 4 inches for the connectors. The monochrome model's maximum cable length is 500 feet. The VGA version, however, can handle only up to 100 feet.

At the terminal end, the cables attach to a small box with connectors for the keyboard, monitor, and a single serial port. For monochrome workstations, a parallel printer port is also included in the interface box. A 25-foot roll of cable for the VGA system costs $80; a 100-foot roll is $225, and custom cables are also available.

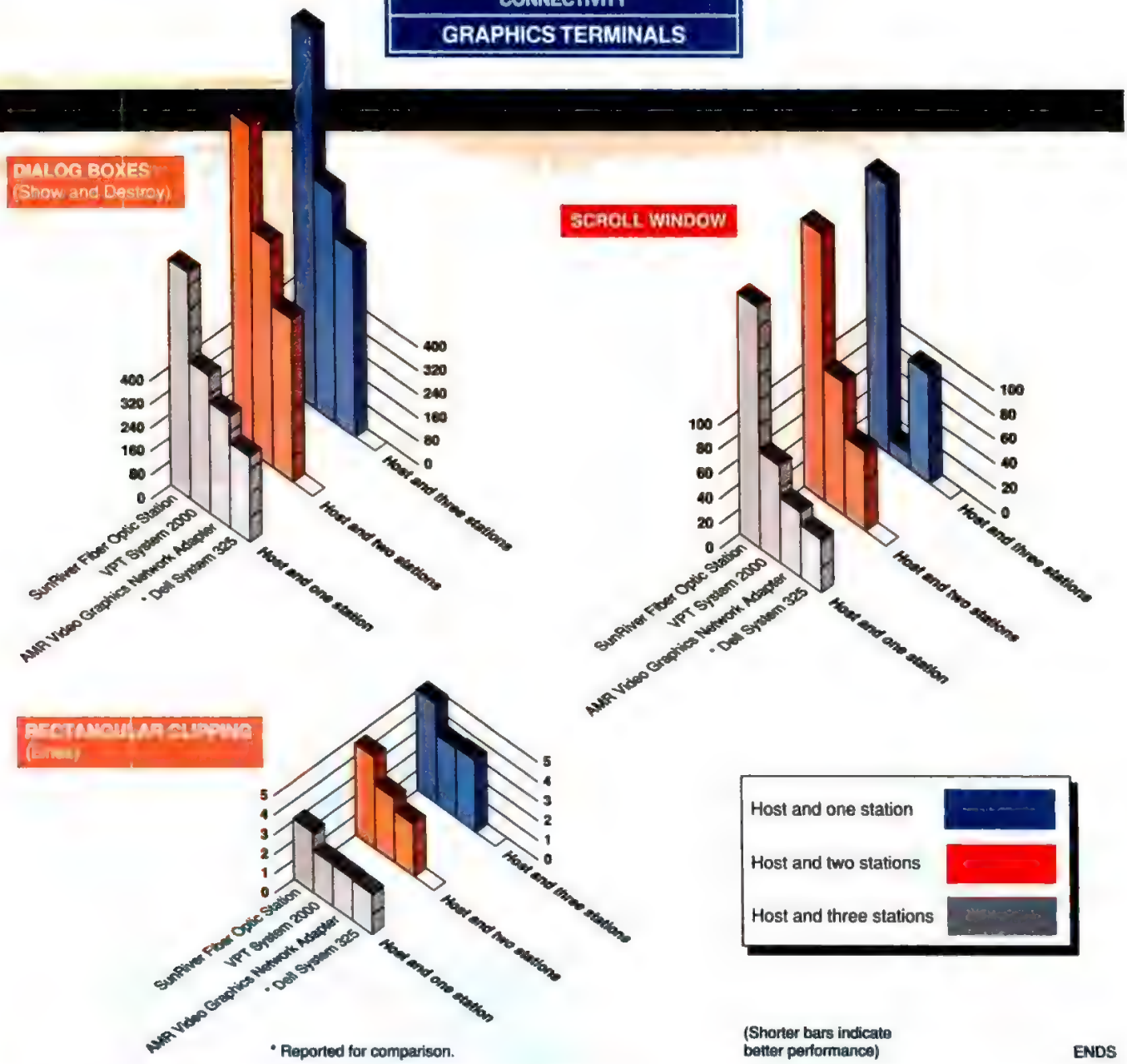
If you wish to use existing 8088/86 or 286 PCs as terminals in a multiuser environment, you can select another option that's called the Connect Card.

The AMR hardware supplies only the remote terminal connections. You'll still need a video adapter for the host machine. There are some IRQ decisions you'll need to make during installation, but the manual's explanations are clear.

COMPATIBLE SYSTEMS

AMR's workstation products are compatible with a number of operating systems. In the DOS arena, the choices are the Software Link's *PC-MOS/386* and IGC's *VM/386*, which offer both multiuser and multitasking support for the 386.

In the Unix arena, AMR supports SCO Xenix and 386/ix, as well as Unix System



* Reported for comparison.

Host and one station
Host and two stations
Host and three stations

(Shorter bars indicate better performance)

ENDS

Advance Micro Research's Video Graphics Network Adapter, a mother/daughterboard set, supports two VGA terminals through connectors that send signals for the monitor, keyboard, and serial port over a 3/8-inch multiconductor cable to the terminal box. The monitor and keyboard must be purchased separately.

V, to which an AMR workstation looks like just another terminal. The VGNA and VNA products support low-cost graphics terminals for Unix-specific applications.

With two terminals running *Ventura Publisher* and two more running *Lotus 1-2-3* and *WordPerfect* 5.0, the AMR's performance subjectively appeared about the same as you would get from a standalone 386 PC. In fact, the VGNA system usually outperformed all of the other alternatives except standalone DOS. When all the stations were active, the delay in screen scrolling and other intensive tasks was only slightly noticeable.

A 25-MHz 80386 can reasonably support up to four graphics users simulta-

neously. After that, task switching can cause jerky display scrolling and cursor movement.

The bottom line? The AMR system furnishes excellent graphics capabilities at a very good price. This computing solution will satisfy many professional organizations looking for an economical way to run practically any graphics application.

SUNRIVER CORP.

SunRiver Fiber Optic Station

According to SunRiver Corp., its Fiber Optic Station was the computer industry's first bitmapped graphics terminal designed for 386-based multiuser systems. Being first to market has many advantages, including the chance to garner more third-party support, but it also makes you a target for vendors wanting some of the action.

SunRiver offers four different models of fiber-optic stations ranging from monochrome with Hercules graphics to full VGA. There are several parts to the system. First, you need a LightAdapter interface card inside the machine acting as a host. These cards come in AT-bus and Micro Channel versions, and each board can handle up to four remote workstations.

The rest of the system consists of connecting cables and the desktop workstation. SunRiver has EGA and VGA stations available, and you can mix the types of stations as long as you can separately configure the application software. The SunRiver VGA terminals use Mitsubishi monitors with optional analog inputs and excellent screens. You pay a lot for this hardware, but it is very high quality.

Each workstation's terminal box, which acts as a pedestal for the monitor, includes an IBM PC–compatible 8254 counter/timer with a speaker, as well as one parallel and two serial ports for connecting a printer and serial devices.

When you add all this up, a system with four VGA workstations costs about $2,600 per station, not counting the price of the single PC acting as host.

OTHER OPTIONS

You can also connect existing VGA-based PCs to the host using a $999 ($799 for EGA-based) PC LightCard. This card gives a PC, XT, AT, or compatible the ability to act as a multifunction workstation. It allows you to access the shared resources of the host PC while retaining your investment in existing PCs.

SunRiver sells cables with the connectors installed in lengths ranging from 50 to 1,000 feet. Costs start at $99 for a 25-foot cable and go to $1,259 for a 1,000-foot roll. Also available from SunRiver is a system the company calls CADLight, which is aimed at *AutoCAD* users.

HIGHLY SUPPORTED

Among the DOS-based multiuser environments, SunRiver has drivers for all of the popular ones. These include *Concurrent DOS 386/MGE*, *PC-MOS/386*, *Quick Connect/386*, *THEOS DOS*, *386/MultiWare*, and *VM/386 MultiUser*. This broad support gives users a choice of operating systems without restricting them to a single vendor.

SunRiver's Unix support includes SCO Xenix/Unix System V, 386/ix, and AT&T System V Unix. In addition, SunRiver offers the first multiuser, multitasking support for *AutoCAD* on the market. (Drivers for other application software are available as well.)

Installing the SunRiver Fiber Optic Station is a breeze: the host adapter fits into a single slot in an ISA- or MCA-bus PC. Each workstation requires a dual fiber-optic cable for sending and receiving. The user manual supplied with the SunRiver workstations has detailed installation instructions for each major operating system, although we think that anyone who understands DOS subdirectories and can screw together a few parts should have no problem installing the multiuser system.

If you do happen to run into trouble, SunRiver offers technical support through an 800 number and has a mail-in card repair or replacement service as well. The standard warranty period on all SunRiver products is one year.

ARCHITECTURE AND FEATURES

The architecture of the SunRiver Fiber Optic Station is quite different from that found in the AMR and Viewport products. Sun-

FACT FILE

SunRiver Fiber Optic Station
SunRiver Corp., 11500-1 Metric Blvd., #150, Austin, TX 78758; (512) 835-8001.
List Price: LightAdapter fiber-optic server interface card: for AT bus, $699; for MCA bus, $899. SunRiver Fiber Optic Station (includes monitor and keyboard): for 800 by 600 VGA, $1,999; for 640 by 350 EGA, $1,499. LightCard for standalone PCs: VGA, $799; EGA, $599.
Requires: 386-based host PC, compatible multiuser operating system. For Hercules monochrome system, compatible monitor and keyboard per workstation.
In Short: The SunRiver Fiber Optic Station is a complete and sophisticated multiuser graphics solution that can suit most needs. Using fiber-optic cable for the distribution medium allows the workstation to be up to 1,000 feet from the host. Without doubt, this is the Cadillac of the bunch.

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SunRiver Corp.'s Fiber Optic Station includes a LightAdapter board (shown in the AT-bus version), connecting fiber-optic cable, keyboard, VGA monitor, a terminal box that also serves as a pedestal for the monitor, an 8254 counter/timer, plus one parallel and two serial ports.

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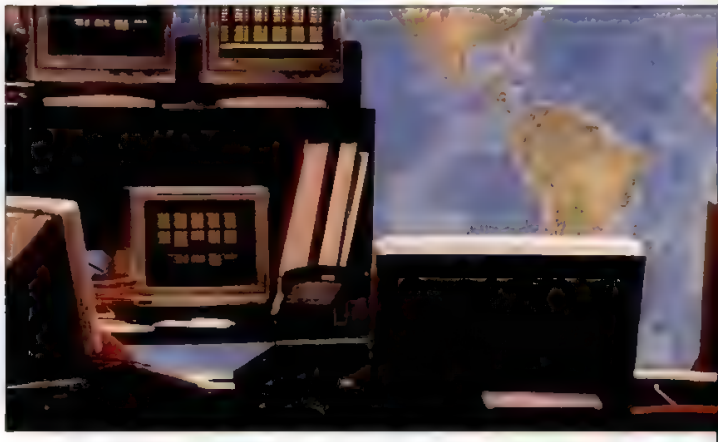

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River puts the video hardware out at the end of the fiber-optic cable instead of in the bus of the host system.

This configuration gives it several advantages: the cables can be longer and are less susceptible to electrical imbalances, such as ground loops or electromagnetic interference; also, installation procedures aren't controlled by electrical codes. In addition, the high speed of the fiber-optic cables allows you to connect two serial ports and a parallel port at every terminal.

SunRiver's bus extension architecture also gives you room for growth. Since the video adapter is close to the terminal, it should be easy for SunRiver to upgrade to 1,024-by-768- and 1,280-by-1,024-pixel displays soon.

On the downside, the fiber-optic hardware costs more and, because the video hardware talks to the CPU over a path that includes communications and translation of data into different formats, the video response is slower than in systems with the video in the data bus. The difference in video response between local and remote hardware architectures isn't subjectively noticeable in actual applications, but it showed up clearly on our tests.

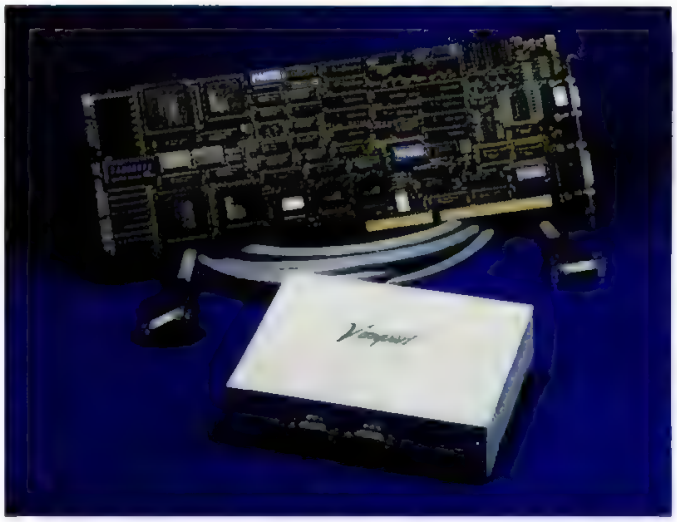
The SunRiver Fiber Optic Stations fit nicely into an organization that needs flexible and high-quality color graphics displays. They are costly compared with the competition, but this architecture has strong potential for easy growth into screen resolutions that the competition will have to work very hard to match.

VIEWPORT TECHNOLOGY INC.

VPT System 2000

Even though today the Viewport Technology VPT System 2000 products offer only color EGA services, with delivery of color VGA expected soon, their price/performance benefits make them worth a look right now. You can install a Viewport system with multiuser color EGA graphics for about $1,350 per workstation, plus the cost of the host machine.

Since the Viewport system includes the serial I/O and video for the host machine, you can use a bare-bones PC as the host. And because everything is on the Viewport boards, there is no tricky juggling of IRQs and memory addresses. This makes installation a snap.



Two connectors on Viewport Technology's VPT System 2000 board attach to cables leading to each workstation's terminal box, which relays signals for the monitor, keyboard, and serial ports. Since the VPT system includes the serial I/O and EGA video for the host machine, you can use a bare-bones PC as the host.

In addition to the VPT System 2000, the company offers the VPT System 1000 for multiuser Hercules terminals.

FULLY POPULATED BOARDS

Unlike the AMR host board, which uses a mother/daughterboard arrangement, the VPT boards are fully populated. Two connectors on the board attach to cables that lead to each workstation's terminal box, which relays signals for four connectors: monitor, keyboard, COM1, and COM2.

The VPT System 2000 comes in two flavors. The 2000-1 is meant for a single host system that uses the first EGA terminal for itself and the second for a remote workstation. The 2000-2 is meant for two remote workstations. You can install up to four of these cards in a single PC for a total of eight remote users in the system.

The adapter for the VPT 2000 uses the Chips and Technologies VGA chip set, whose popularity should ensure compatability with many graphics products.

At this time, the system is available only in AT-bus versions. Maximum cable length is 250 feet. The cables for the VPT systems are similar to those AMR uses: about ⅜ inch in diameter and about as flexible as a printer cable.

The VPT systems support a large number of DOS multitasking systems. The list includes *Concurrent DOS 386*, *PC-MOS/386*, *Quick Connect/386*, *VM/386*, and *VMOS*. One side note: although Viewport is a subsidary of IGC, *VM/386*'s distributors, it nevertheless provides support for all of *VM/386*'s competitors.

Unix support is provided for SCO/Unix System V and *THEOS DOS*. As with the AMR products, the Viewport drivers for standard Unix simply make the workstations look like an additional terminal to the operating system, which makes it easy to use existing applications.

Viewport sells primarily to distributors, VARs, and OEMs; therefore, the service you get is usually from these outlets. Free technical support, as well as warranty repair service, is available for one year.

Although its present EGA-only status might limit its attraction for some users, the VPT system is a cost-efficient solution that will meet the needs of many organizations. The low cost per node makes the system an attractive alternative to the SunRiver station, and the fact that workstations can be 250 feet away from the host gives greater installation flexibility. ■

FACT FILE

VPT System 2000
Viewport Technology Inc., 4800 Great America Pkwy., #410, Santa Clara, CA 95054; (408) 748-1495.
List Price: VPT System 2000-1 EGA graphics (for a host system that uses the first EGA terminal for itself and the second for a remote workstation), $1,538; VPT System 2000-2 EGA graphics (for two remote workstations), $1,799.
Requires: 386-based host PC, multiuser operating system, compatible monitors and keyboards.
In Short: Although graphics resolution in the Viewport VPT System 2000 is currently limited to EGA—with VGA expected soon—this is the least expensive solution we tested. With its wide array of software support, it could be a contender now for applications that don't require higher-resolution VGA displays.

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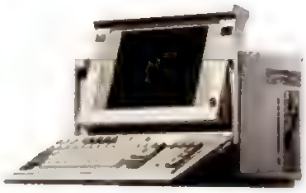

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International Fax #312-633-2888 International Voice #312 226 5200 We are open Mon. thru Fri.: 8am to 6pm Central Time. MasterCard, VISA, Discover, Checks and Approved P.O.s are Accepted. Prices and specifications subject to change. PCM 9-14

*TRW- National Computer Maintenance Services †5 Year Limited Warranty, details available on request

Entry Level

Not everyone needs a 386.

If your application calls for data entry, word processing, or general business support, a low cost entry level system can be an ideal solution.

But the latest versions of the industry's software standards like Lotus 3.0, Windows 3.0, Microsoft Word and DBase IV need more processor speed and memory than most 8088/86 entry level machines can muster.

Starting at only $599 for a true 16MHZ 286, supporting up to16Mb of RAM and over 200Mb of hard disk storage, *PC Brand truly redefines entry level computing.*

Now even the most complex software packages perform with the speed necessary to support the most demanding user.

You get all this plus our exclusive 5-year limited warranty, and the most comprehensive toll-free service and support package in the industry.

PC Brand 286/16

286/16 $599

16 MHz Clock,
Zero Wait Operation,
Norton SI 19.0
Landmark™ Speed 20.6MHz,
512K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

286/20 $699

20 MHz Clock,
Zero Wait Operation,
Norton SI 23.0
Landmark™ Speed 26.7MHz,
512K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

PC BRAND 286's

Add the following amounts to the base configuration prices shown above

Hard Drives MB/MS	20/40	40/19	71/25	110/17	200/19
Mono	$450	$550	$730	$870	$1320
VGA-Mono	$630	$730	$910	$1050	$1500
VGA-Color	$860	$960	$1140	$1280	$1730
SVGA/Color*	$970	$1070	$1250	$1390	$1840
Portable VGA	NA	$2470	NA	$2790	$3240

For benchmark scores on hard drives, see "Pure Power" pages
* SVGA 1024 x 768 interlaced

Standard Features:

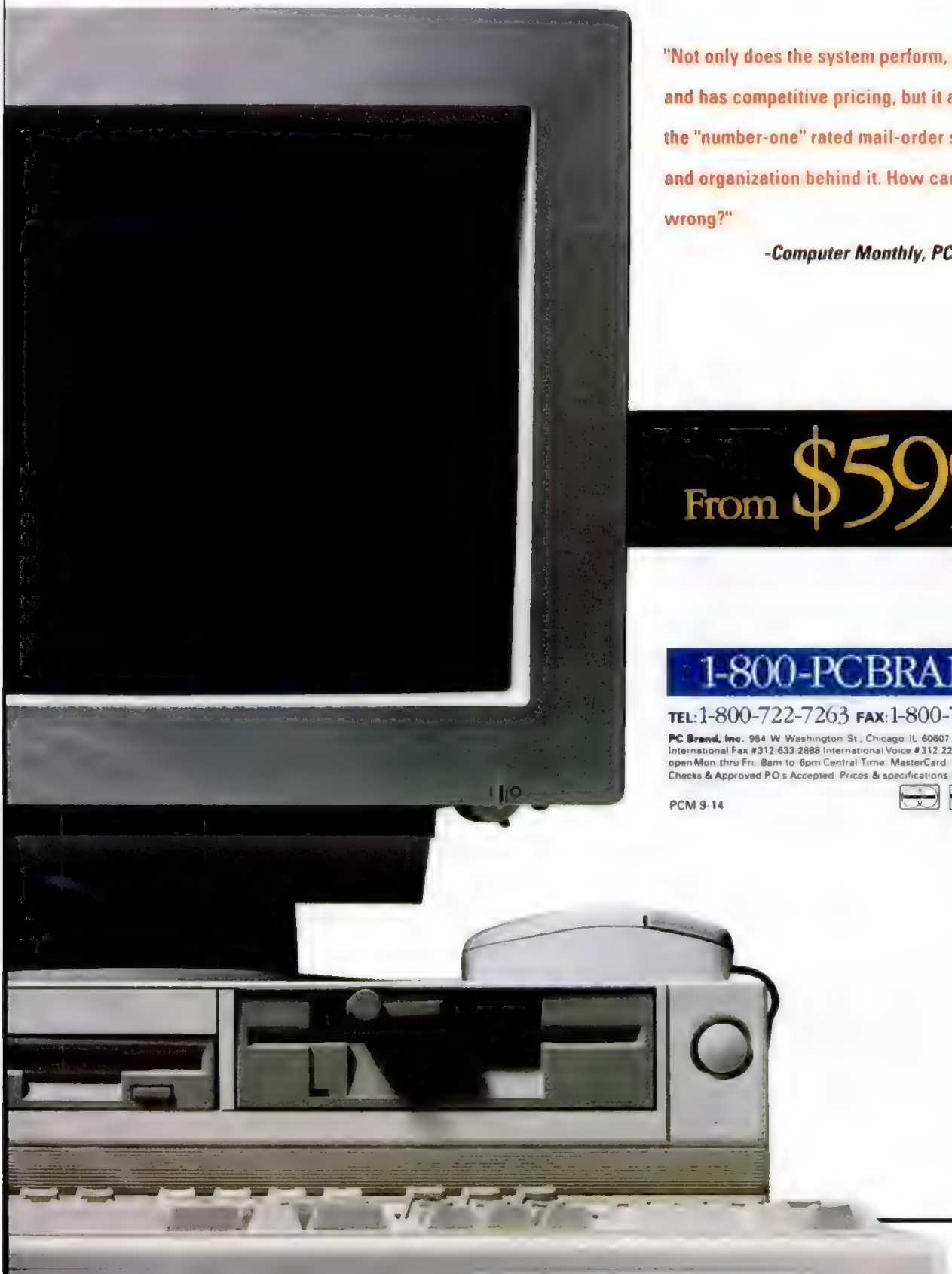
- 80286-16, 80286-20 operating at 16MHz, or 20MHz w/Zero Wait
- 512K RAM expandable to 8MB on the System board using 256K or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability on all VGA Systems
- 1:1 Interleaved Hard/Floppy Drive Controller, 1Mb/Second disk transfer rates on all 40Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports
- High Capacity System Power supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- AMI BIOS w/full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM and PCNET compatibility
- Built-in System Board LIM 4.0EMS hardware
- User configurable I/O timing permitting compatible operation with older peripherals or faster I/O for newer devices
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 6 Disk Drive bays

Options:

- Low profile Slim Line Case with 3 Disk Drive bays
- Mini Size desk top Tower* Case with 4 Disk Drive bays
- VGA Plasma Portable Case
- Factory Installed RAM Upgrades
- Custom configurations with Name Brand peripherals of your choice

*Tower is a registered trademark of NCR Corp

Redefined.



"Not only does the system perform, look good and has competitive pricing, but it also has the "number-one" rated mail-order service and organization behind it. How can you go wrong?"

-Computer Monthly, PC Brand 286

From $599

1-800-PCBRAND

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PCM 9-14

The Work

Our 386 intermediate systems (the "Workhorses" as we call them) earn their way into your office and onto your desktop through remarkable price and performance.

Designed to meet the complex and demanding workload of today's business environment they work for a living performing full time applications like Accounting, Desktop Publishing, Data Bases and Local Area Networks with ease.

At an outstanding $799 for a 386SX or an even more unbelievable $1299 for a full fledged 386DX 25MHz processor these units will pay for themselves in no time!

Combine this with On-Site Service by TRW*, toll free technical support, custom configurations and other user care programs unheard of in the industry, and your choice is clear-PC Brand.

386SX's From $799

386/SX-16 $799

16 MHz Clock,
Zero Wait Operation
Norton SI 18.7
Landmark™ 18.3MHz,
512K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

386/SX-20 $999

20 MHz Clock,
Zero Wait Operation
Norton SI 18.7
Landmark™ 18.3MHz,
512K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

Standard Features:*

- 80386SX Processor Operating at 16 or 20MHz delivering 18 or 22.5MHz Effective Throughput
- 512K RAM expandable to 8MB on the System board using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability on all VGA Systems
- 1:1 Interleaved Hard/Floppy Drive controllers, 1 Mb/Second disk transfer rates on all 40Mb drives or larger
- Enhanced 101-key Click/Tactile Keyboard
- 2 Serial & 1 Parallel ports
- High Capacity 200Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387SX Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 6 Disk Drive bays

Options:

- Low profile Slim Line Case with 3 Disk Drive bays
- Mini Size desk top Tower* Case with 4 Disk Drive bays
- VGA Plasma Portable Case
- Factory Installed RAM Upgrades
- Custom configurations with Name Brand peripherals of your Choice

PC BRAND 386/SX's

Add the following amounts to the base configuration prices shown above

Hard Drives: MB/MS	20/40	40/19	71/25	110/17	200/19
Mono	$450	$550	$730	$870	$1320
VGA-Mono	$630	$730	$910	$1050	$1500
VGA-Color	$860	$960	$1140	$1280	$1730
SVGA/Color*	$970	$1070	$1250	$1390	$1840
Portable VGA	NA	$2470	NA	$2790	$3240

For benchmark scores on hard drives, see "Pure Power" page
* SVGA 1024 x 768 interlaced

PC BRAND™

*Tower is a registered trademark of NCR Corp.

Horses.

"Faster Than A Speeding Bullet"
-Computer Shopper, Cover Story

"The Best Low Cost Alternative Around!"
-PC Magazine, 25MHz 386PC's

"The Biggest Bargain In Personal Computing"
-Computer Buyer's Guide, Cover Story

386/25-$1299

386/25 $1299

25 MHz Clock,
Zero Wait Operation,
Norton SI28 2
Landmark™ Speed 33.6MHz,
1024K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

Standard Features:

- True 25MHz Intel 80386 CPU Operating with Zero Wait States
- 1024K RAM standard expandable to 16MB using 256K and/or 1MB RAM
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability on all VGA Systems
- 1:1Interleaving Hard Drive/ Floppy Drive controllers, 1Mb/Second disk transfer rates on all standard Drives
- Enhanced 101-key Click/Tactile Keyboard
- 2 serial & 1 parallel ports
- High Capacity 200Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287, 80387, or Weitek Co-Processor Support
- AMI BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- 8 Slot motherboard design (5 16Bit & 3 8Bit)
- Medium foot print case with 6 Disk Drive bays

Options:

- Low profile Slim-Line Case with 3 Disk bays
- Full Size Tower* Case with 8 Disk Drive bays
- Mini Size Tower* Case with 4 Disk Drive bays
- VGA Plasma Portable Case
- Custom configurations with Name Brand peripherals of your choice

PC BRAND 386/25

Add the following amount to the base configuration price shown above

Hard Drives MB/MS	40/19	71/25	110/17	200/19	320/16	640/15
Mono	$550	$730	$870	$1320	$1870	$2660
VGA-Mono	$730	$910	$1050	$1500	$2050	$2840
VGA-Color	$960	$1140	$1280	$1730	$2280	$3070
SVGA/Color*	$1070	$1250	$1390	$1840	$2390	$3180
Portable VGA	$2670	NA	$2990	$3440	NA	NA

For benchmark scores on hard drives, see "Pure Power" page
* SVGA 1024 x 768 interlaced

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*TRW National Computer Maintenance Services On Site Service for 386/SX DX and 486 only 286 On Site is available at an extra cost Ask for details

*Tower is a registered trademark of NCR Corp. PCM 9-14

Pure

Whether used as large scale file servers, CAD CAM workstations, UNIX hosts or statistical simulation engines these machines are guaranteed to satisfy even the hungriest "power applications", truly mainframes on a desktop.

And like all PC Brand systems, they do it at an unbelievable price! Our 386/25 Cache starts at only $1599 while the top of the line 486's begin at just $3949.

486's from $3949

486/25 $3949

25 MHz Clock,
Zero Wait Operation
Landmark™ 113.6MHz,
4MB RAM,
1.2MB and 1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

486/33 CALL

33 MHz Clock,
Zero Wait Operation
Landmark™ 149.9MHz,
4MB RAM, 1.2MB and
1.44 MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

Standard Features:

- True 25 or 33 MHz INTEL 80486 CPU operating at Zero Wait States
- 4MB RAM standard example to 32 MB
- Built-in 8K 4-way set associative cache
- Built-in INTEL 487 Numeric Coprocessor
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability on all VGA systems
- 1.2MB 5 25" and 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/ Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all standard Drives
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial,1 parallel
- High Capacity 200Watt System Power Supply
- 8 Slot motherboard design with one 32bit proprietary Zero Wait States Slot
- Full Posted Write Mode increasing heavy memory requirement task speed by 10%
- AMI BIOS with MS/DOS, OS/2, XENIX, UNIX, NOVELL,3COM compatibility
- Full Size Tower* Case with 8 Disk Drive Bays
- On Board NiCAD Battery

Options:

- Factory Installed RAM Upgrades
- Custom configurations w/ Name Brand peripherals of your choice

PC BRAND 486's

Add the following amount to the base configuration price shown above

Hard Drives: MB/MS	71/25	110/17	200/19	320/16	640/15
Mono	$730	$870	$1320	$1870	$2660
VGA-Mono	$910	$1050	$1500	$2050	$2840
VGA-Color	$1140	$1280	$1730	$2280	$3070
SVGA/Color*	$1250	$1390	$1840	$2390	$3180

For benchmark scores on hard drives, see opposite page
* SVGA 1024 x 768 interlaced

Power.

If you like, PC Brand can configure and install NOVELL, UNIX and other complex hardware/software combinations at the factory to your exact specifications, taking complete responsibility for putting these products to work.

"...Flawless Compatibility, Lowest Price"

-InfoWorld, Product Review

386 Cache From $1599

386/25 $1599

25 MHz Clock,
Zero Wait Operation
Norton SI 31.6
Landmark™ 43.5MHz,
512K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

386/33 $2099

33 MHz Clock,
Zero Wait Operation
Norton SI 45.9
Landmark™ 58.7MHz,
1024K RAM, 1.2MB or
1.44MB Drive,
101-Keyboard,
2 Serial and 1 Parallel Ports

Standard Features:

- True 25 or 33MHz INTEL 80386 CPU operating w/Zero Wait States with 43.5 or 58.7 MHz Throughput
- Intel 82385 Cache Processor with 32K 25NS Static RAM Standard
- 1024K RAM Standard Expandable to 16MB
- FCC Class "A", Intended for business use
- High performance 16bit VGA Cards with optional 1024x768 capability
- 1.2MB 5.25" or 1.44MB 3.5" Diskette Drive
- 1:1 Interleaving Hard Drive/ Floppy Drive Controllers, 1 Mb/Second disk transfer rates on all standard drives
- Enhanced 101-key Click/Tactile Keyboard
- I/O Ports-2 serial, 1 parallel
- High Capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80387 or Weitek CoProcessor support
- Phoenix BIOS with Full MS DOS, OS/2, XENIX, UNIX, NOVELL, 3COM compatibility
- EMS and Disk Cache in ROM
- 8 Slot motherboard design
- Medium foot print case w/6 Disk Drive bays

Options:

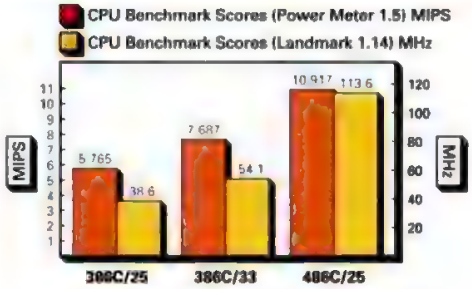
- Full size Tower* Case w/8 Disk Drive bays
- Low Profile Slim Line Case w/3 Disk bays
- Mini Sized Tower* Case w/4 Disk Drive bays
- Custom configurations w/ Name Brand peripherals of your choice
- Factory Installed Ram Upgrades

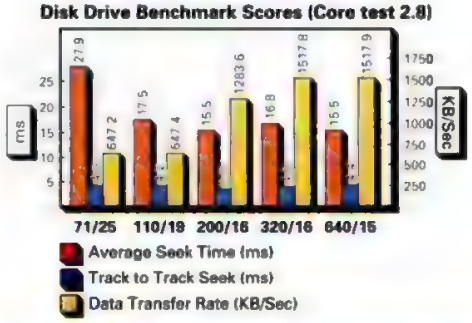
PC BRAND 386 Cache

Add the following amount to the base configuration price shown above

Hard Drives: MB/MS	40/19	71/25	110/17	200/19	320/16	640/15
Mono	$550	$730	$870	$1320	$1870	$2660
VGA-Mono	$730	$910	$1050	$1500	$2050	$2840
VGA-Color	$960	$1140	$1280	$1730	$2280	$3070
SVGA/Color*	$1070	$1250	$1390	$1840	$2390	$3180
Portable VGA	$2670	NA	$2990	$3440	NA	NA

* SVGA 1024 x 768 interlaced





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PCM 9-14

Floppy Disk Drives

360K 5.25" Half Height Black $75
720K 3.5" Half Height Black 80
1.2M 5.25" Half Height Grey 85
1.44M 3.5" Half Height Grey 95

Syegen

Bridge-File 5.25" 360K/1.2MB External .. $229
Bridge-File 3.5" 720K/1.44MB External ... 229
Bridge-File PC/AT Adapter 59

Hard Disk Drives

Compaq/Conner IDE Upgrades

40M 28ms ..... $459 100M 25ms .. $679
200M 19ms 1249

Iomega

B1201 20M Int. $765 B1441 40M Int. . $995
B244X Dual 5.25 44M External 1995
PC2/50 NonbootableCard 169
PC2B/50 Bootable Card 230

Plus Hardcards

Hardcard 20 8 bit $539
Hardcard 40 8 bit or 16 bit 599
Hardcard 80 16 bit 695

Seagate

20M 65ms ST225 Half Height $209
20M 35ms ST125 Half Height 229
30M 35ms ST138 Half Height 245
40M 28ms ST251-1 Half Height 319
40M 24ms ST151 Half Height 419
80M 28ms ST4086 MFM 590

Add $50 for XT Kit for ST1xx, ST2xx

Tape Backups

Archive/Maynard

ST600 Int. or FT60 Ext. 60MB w/cont. $590
FT150I 150MB Internal with controller 895
VP150I 150MB Internal Novell certified 895

Peripherals & Software

Monitors

Cornerstone Technology

19" Dualpage Display/16 level $1950/2795

Mitsubishi

1381 14" Diamond Scan (to 800x600) $499
HL6605 16" SVGA/EGA (to 1280x1024) .. 1195
HL6905 20" SVGA/EGA (to 1280x1024) .. 2095

NEC

GS-2A 14" MultiMono (to 800x600) $249
2A 14" SVGA (800x600) 479
3D 14" SVGA/EGA (1024x768i) 649
4D 16" SVGA/EGA (1024x768) 1150
5D 20" SVGA/EGA (1280x1024) 2350

Panasonic

C1391 PanaSync (to 800x600) $489
M1500 15" Mono DTP w/adapter 1208
M1900 19" Mono DTP w/adapter 1498

Princeton Graphics

Max15 14" Mono (to 1024x768i) $249
UltraSync 14" SVGA/EGA (800x600) 520
UltraSync 16" SVGA/EGA (1024x768i) 879

Princeton Publishing Labs

Multiview 15" Mono DTP w/adapter .. $690

Relisys

9503 14" VGA Mono (640x480) $145
9513 14" VGA Color (640x480) 369
1520 15" SVGA (1024x768) 679

Samsung/Leading Technology

14" VGA Color .31DP (640x480) $369
14" VGA Color .41DP (640x480) 299
14" SVGA Color (to 1028x768i) 419

Seiko

1440 14" SVGA (1024x768i) $599

Sony

Multiscan HG 14" SVGA (to 1024x768) . $689
GDM-1606 16" CADD (1280x1024) ... Call
GDM-1953 19" CADD (1280x1024) ... Call

Zenith

ZCM1492 VGA Flatscreen (640x480) $619

Video Cards

ATI

VGA Wonder 256K/512K $245/297

NEC

PC Magazine's Editors Choice

Graphics Engine 16 (1024x768) $679
Graphics Engine 256 (1024x768) 969

Paradise

VGA 1024 with 256K 235
VGA 1024 with 512K 265
8514/A Plus 569
VGA memory Upgrade 199

Video Seven

1024i VGA with 256K/512K $239/299
VRAM VGA with 512K 469

Modems

ATI

2400ETC Internal with MNP5 ..... $165
2400ETC External with MNP5 205

Hayes

1200B Internal with Smartcom $189
2400B Internal with Smartcom 259
1200 External .. 285 2400 External .. 359

PC Brand (100% Hayes Compatible)

1200 Internal with software $49
1200 External .... 70 2400 External .. 129
2400 Internal w/software/MNP5 .... 75/129

US Robotics

Courier HST 14,400 Int./Ext. $579/589
Courier V.32 9600 External 889
Courier HST/V.32 External 995
Courier HST 9600 Internal 579

Fax Cards

Complete PC

Complete Fax 4800/9600 ..... $249/399
Complete Communicator 549
Complete Portable Fax 9600 309

Intel

Connection Coprocessor $529

Quadram

4800/9600 ..... $199/495

Co-Processors

Intel

8087-1 ..... $189 8087-2 ..... $129
80287-10 ..... 229 80387-SX 309
80387-16 ..... 349 80387 20 399
80387-25 ..... 479 80387-33 599

Weitek

Abacus 20/25/33 ..... Call

*Oversized Monitors, Plotters, Laser Printers, and Portables excluded from Free Freight.

VP150E 150MB External Novell certified . 1175
VP402 Interface Board for VP Series 115
VP409 PS/2 Interface Board for VP Series 230
VP60 Internal/External 639/779
Maynstream 60MB Portable $889
Maynstream 150MB Portable 1395
Maynstream 2200HS 2.2GB Portable .. 4350

Colorado Memory Systems

DJ-10 Jumbo 40/80MB Internal $249
KE-10 External Chassis Kit with Interface 139
QFA500 ..... Call

CD-ROM

Amdek

Laserdeck 2000 500MB External Kit $619

Microsoft

Bookshelf 1.0 $195 Stat Pack $99
Programmer's Library 295

NEC

CDR80 Internal $499
XT/AT Interface Kit 129
Clipart 3D ..... 285 Image Folio ... 285

Sony Kits

CDU510 Int. .. $665 CDU1701 Ext. $779

RAM/I-O and Accelerator Boards

Intel

Aboveboard Plus 512K $419
Aboveboard Plus I/O 469
Aboveboard Plus 8 2Mb/I/O 2 Mb ... 599/629
Inboard 386 PC with 1M 595
Inboard 386 AT with 0K 859

PC Brand I/O Cards

AT 1P/2S/1G $49
XT 1P/1S/1G/Clock/Calendar 49

Printers

(Numbers in Parentheses Indicate Draft/LQ CPS)

Canon
BJ130e 15" .... $695 LBP4 Laser $995
LBP8-III Laser 8PPM 1650

Citizen
GSX 140 (192) $329 GSX200 ..... Call

Epson
LX810 (180/30) $179 FX850 (264/54) $329
FX1050 (264/54) 439 LQ510 (180/60) 289
LQ850 (330/88) 495 LQ950 (330/88) 495
LQ1010 (180/60) 439 LQ1050 (330/88) 669
LQ2550 (400/108) 899 EPL6000 6PPM 939

Hewlett Packard
Deskjet Plus .. $710 LaserJet IIP . $1025
Laserjet III ..... 1650 Laserjet IID 2995

Laser Jet Accessories

Adobe (New!)
HPLJII Postscript Cartridge ..... Call

Pacific Data Products
Plotter in Cart. for II/IIP $249/269
25 in 1 Cart. 285
Postscript Cart. for III or IIP 375
1M Memory Card for IIP 275

CPI
Superfont Cartridge ..... Call
Jet Memory 1M 174
1M Expansion 96

Princeton Publishing
PS 388 Postscript board $2250

Call about 400dpi Postscript Compatible Laser Printers

Networking Hardware

Gateway
G/Ethernet AT $435 for PS/2 ..... $435
G/Ethernet (8 bit) 265

Lantastic
2 MBs Starter Kit/Adapter $419/195
Ethernet Starter Kit/Adapter 575/279

Standard Micro
PS110 Board for PS/2 ..... $395
PC500 16 Bit for WS/Server 260/335
PC550 16 Bit Tw. Pr. for WS/Server ... 291/355
PC270E Twisted Pair 139
PC130 Arcnet Board 117
ARCNET passive hubs/active hubs 72/321
ARCNET intell. hub coax/Tw. pr. . 495/609

Synoptics
505UTP Transceiver $139
1000 Conc./2500 Workgroup Conc. ... 2575/839

Tiara
4 port hubs $49
8 port hubs 285
Lancard/A 8 bit ARCNET 89
Lancard/A 16 bit ARCNET Board 249
Lancard/E 8 bit Ethernet 199
Lancard/E 16 bit ARCNET Twisted Pair 339
Lancard/E 8 bit Twisted Pair 329

Tops
Repeater $125
Flashcard $155

Western Digital
Ethercard+ 8 bit $185 Twisted Pair .. $319
Ethercard+ PS/2285 /EPB PS/2 285
Ethercard+ 8 bit with ROM Socket 205
Ethercard+ 16 bit 255

Xircom
Pocket ARCNET Adapter Coax or Tw. Pr. $295
Pocket Ethernet Adapter Twisted Pair 489

Novell Networking

(Novell Authorized Sales and Support)

4 User ELS Level I v. 2.12 ..... $489
8 User ELS Level II v. 2.15 1049
Advanced Netware v. 2.15 1850
SFT Netware 286/Netware 386 2850/4550

Network Utilities

Brightwork Development
PS-Print ..... $415 Queue ITI $119

CC: Mail
25 User ..... $495 Expand $445
Remote ..... 235 Gateway 895

Cheyenne Software
Netback ..... $189 Monitrox $505

Da Vinci eMail Servers
DOS ..... $849 DOS/Windows $1349

Lan Systems
Lanspace ..... $310 Lanspool $259

Norton-Lambert Close-up
Support 3.0 ... $165 Customer 3.0 $135

Ontrack
Disk Manager -N$99 Netutils $85

Tops
NetPrint 2.0 ... $145 Network Bundle $169

Traveling Software
Desklink 2.2 .... $95 Laplink III $92

Unix/Xenix Multiuser Products

Digiboard
Intelligent Serial Cards:
4 Port/8 Port $645/795

Software

Autosketch Animator $239
Borland Quattro 95 Quattro Pro 329
Caere Omnipage 386 2.1 619
Datastorm ProComm Plus 52
dBase IV ..... 479 Microrim R:Base 489
Delrina Perform 2.0 159
Delta Technology Direct Access 59
Deskview 386 v. 2.2 125
Fifth Generation Fastback Plus 109
Foxbase + ... 189 Harvard Graphics 329
Generic CADD Level 3 205
IBM Displaywrite V NEW! ..... Call
Lotus Freelance Plus 329

At Unbeatable Prices!

Kodak Diconix
150Plus (150/50) $330

NEC
P2200XE (192/54) 335 P9XL (400/100) 1030
P5200 ..... 530 P5300 675
LC890 ..... 3190 LC890XL 4495
LC260 ..... Call LC290M ..... Call

Okidata
ML320 (200/52) $345 ML321 (200/52) $479
ML380 (180/50) 359 ML390+ (270/90) 475
ML391+ (270/90) 655 ML393+ (450/120) 995
OkiLaser 400 4PPM 1010

Panasonic
1180 (192/38) . $189 1191 (240/48) . $245
1124 (192/63) ... 299 1624 (192/63) ... 429
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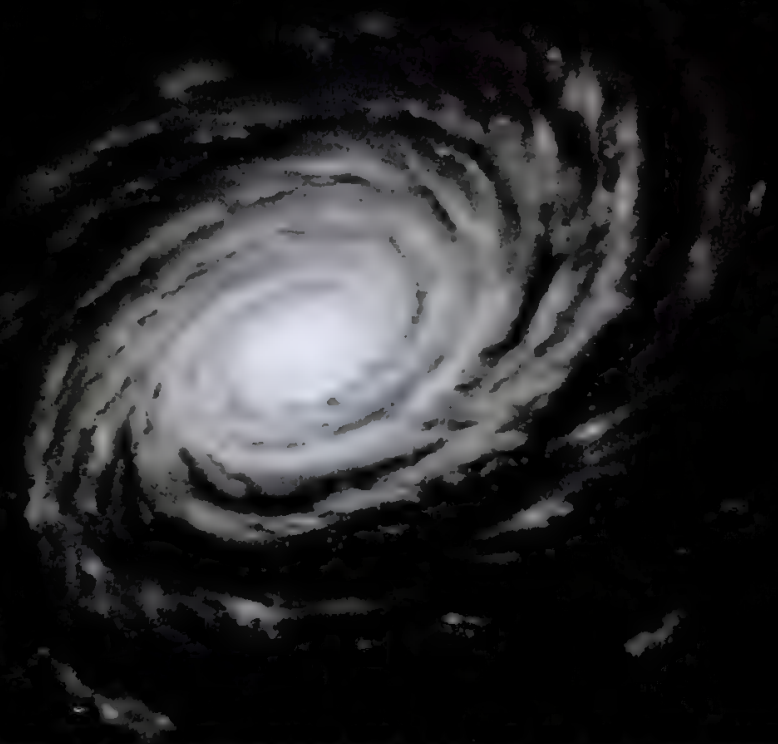

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CIRCLE 313 ON READER SERVICE CARD

by
Neil J. Rubenking

Lab Notes

Exploring and Organizing Your Hard Disk with Lotus's Magellan

Lotus's *Magellan* is best known to productivity-conscious readers as *the* utility that can always find the information you need no matter where you've put it on your PC. It won our 1989 Technical Excellence Award in the Utility category.

But *Magellan* can do much more than simply search files, and the new version, 2.0, is more powerful still. If you have the program, load it now and this Lab Notes will provide a hands-on demonstration of its capabilities. If you don't have *Magellan* 2.0 yet, read on and you'll see why you should add it to your collection of useful programs.

THE EDITOR

I keep the hundreds of items I've edited for User-to-User in a series of subdirectories under a main U2U directory. To facilitate searching these files, I defined a *Magellan* file group that describes them. A *file group* ties together similar files, based on their names, locations, or contents. In my case, the wildcard file specification

```
F:\U2U\*\*
```

defines the group. This is not a valid DOS filespec, of course, but *Magellan* interprets it to mean any file in the U2U directory or a directory below it. The table in Figure 1 shows how *Magellan* lets you expand on the DOS wildcard concept to widen or narrow searches based on their filespec.

Most of the reader submissions I receive come with one or more ancillary files—a batch file, a DEBUG script, or a diagram, for example. Even the smallest file takes up a full cluster of disk space, however, so after they're a few months old, I compress groups of 5 to 10 items. From *Magellan*'s list of files, I simply mark those I want to treat and press Ctrl-F4 to ZIP them up. (*Magellan* includes licensed versions of PKZIP and PKUNZIP for file compression and expansion.) Wonderfully, even the ZIPed files are still completely accessible to *Magellan*: I can search them and display their contents just as if they weren't compressed. Indeed, even if a ZIP file is stored inside another, *Magellan* can still index and display its contents.

> ■ One of the few "must have" utilities for every power user, *Magellan* 2.0 adds new power and flexibility.

PC MagNet subscribers often ask me questions about items from my column. I just tell *Magellan* to Explore the User-to-User file group for the subject being discussed, for example DOS 3.3 environment. Very shortly I have a list of files on the topic, ranked by how closely they match my search criteria. I can browse the files to find the information, then use the Gather command (F5) to paste the data I need into another file.

I also use *Magellan* to help me select submissions for the column. Often an item will sound familiar, but I won't know for sure whether I've already used something on the same topic. Again, I Explore the User-to-User file group, but instead of using a list of keywords, I specify the file in question as the criterion. *Magellan* finds similar files and ranks them by their degree of similarity. If the idea isn't new, I find out right away.

THE PROGRAMMER

Reusing program code can cut down on development time. After you've written one QuickSort, you never have to write one from scratch again—that is, if you can *find* the routine to reuse. With *Magellan*, the first step is to define a file group that identifies program source code files, for example

```
*:\SOURCE\*\*.PAS
```

Then, when you need a QuickSort, Explore this group, looking for the word QuickSort. Browse the selected files to find the one you want, then Gather it to a temporary file for inclusion in your program.

Magellan will not search for substrings—searching for *sort* wouldn't find QuickSort, Assorted, or SortOf. To improve future searchability, you should add a descriptive comment to the start of every routine as you write it. Then you'll be able to search without knowing the exact name of the routine you want.

You'll often want to check every occurrence of a particular variable or subroutine name in a file. *Magellan*'s QuikFind Viewer lets you do this. Highlight the program name, hit the Right Arrow key to move into the view window, and press the Viewer key (Ctrl-F8). Then just pick QuikFind from the resulting menu. Or, if you prefer, press the Ins key repeatedly to cycle through the choices until the QuikFind Viewer comes up. Now type in the variable name, and any line in your file that does not contain the string you've entered will disappear from the window.

A similar task involves finding all the files that refer to a particular variable or

MAGELLAN WILDCARD EXTENSIONS

Wildcard	DOS	*Magellan*
?	One character or none in a filename or extension.	Exactly one character in a drive name, directory name, filename, or extension.
*	Any number of characters (including none) in a filename or file extension. Characters following an * are ignored.	Any number of characters (including none) in a drive, directory, filename, or extension. Characters following an * are recognized.
*	Replaces *.* only in the DIR command.	Replaces *.*
.	The current directory.	The directory from which you started *Magellan*.
..	The parent of the current directory.	The parent of the current directory.
*:	N/A	All drives except removable or remote drives (you can manually include other drives).
*\	N/A	A subdirectory and all subdirectories below it.
**\	N/A	One directory level. For example, C:**\ represents all directories just below the root of drive C:.

N/A—Not applicable; this wildcard is not found in DOS.

Examples:

Path	Meaning
:	All files on all drives.
:.BAT	All batch files on all drives.
C:*\DATA*	All files on C: in all directories named DATA.
*:*X*	Files on all drives that have an X in the filename.
F:**E*D*C*.*	All files on F: whose names contain E, D, and C, in that order, for example, EDC.COM or HEADACHE.DAT.
:\WP***	Files on all drives that are in directories immediately below a directory called WP.
D:\PROG**	All files on drive D: in the PROG directory or any directory below PROG.
:\Z**	Files on all drives that are in directories beginning with Z.

Figure 1: *Magellan* extends the DOS wildcard concept to allow both wider and more narrowly based searches.

subroutine. Again, press the Right Arrow key to make the View window active, and then simply type in the name of the variable. When you start typing, *Magellan* goes into its FIND mode, in which it highlights all occurrences of the string you typed. Pressing the Minus key jumps to the previous occurrence, and the Plus key jumps to the next.

If there are no more matches in the current file, *Magellan* will search for the next file that contains the string. *Magellan*'s FIND mode is slower than making an indexed search, so it's best used when there are just a few dozen files in the list window. Note that you can use FIND mode in the list window too—start typing and *Magellan* will highlight filenames that contain the string you typed. Again, the Plus and Minus keys move to the next or previous highlighted file.

Sometimes a search of your program files will turn up two nearly identical files. Is one a modified version of the other? Are both of them versions of a common ancestor, modified in different ways? To find out, choose the Compare function (Ctrl-F6). *Magellan* will compare the two files and produce a report detailing the differences. The report should help you decide whether to delete one of the files.

There's no need to exit *Magellan* to edit, compile, or debug your programs. You can launch any application you like, including your compiler, editor, and debugger. *Magellan* swaps out all of its own code except for a 10K placeholder, so it will have little impact on your ability to compile large programs. Figure 2 shows a Launch Setup dialog box for Turbo Pascal. When you launch Turbo Pascal, the {Path} keyword in the command string is replaced with the full pathname of the highlighted file.

THE HARD DISK USER

Even if you're neither a magazine editor nor a programmer, chances are that you have a lot of files on your hard disk that aren't where they should be. *Magellan* will help you keep an orderly hard disk, with room to spare. Suppose, for example, that you keep your basic tax records in *Paradox*, but also have some tax correspondence in *WordPerfect*. Most of that correspondence is in your LETTERS directory, but a few tax-relevant files have accidentally been stored elsewhere. When tax time comes, how will you find all your records?

To use *Magellan* to round up your stray tax data, you first issue its Explore command (F9). Select All files as your file group, and use *Income Tax* as the text to search for. You'll presumably want most of the found files, so press Shift-Spacebar to mark them all. Then browse through them, hitting the Spacebar to *unmark* any that don't belong. Now use the Move command (Alt-F2) to move them all to a new directory. If you specify a directory that doesn't exist, *Magellan* will create it. (Alternatively, you can press the Plus key to go into TREE mode and simply navigate to the destination directory.)

Besides gathering related files into one place, *Magellan* can help you get more disk space by disposing of useless files. Press the F9 key to Explore. Select All files, then give the Sort command (F6) and sort by time/date in Ascending order. The oldest files on your disk are now at the top of the list—are any of them obsolete? You can mark a group of files and either delete them or back them up to floppy disks. (Yes, *Magellan* did it right: the Backup command (Ctrl-F1) will split large files across multiple disks.) Sort again, this time by Descending order of Size. The biggest files are at the top of the list—are they all necessary?

Finally, check for duplicate files. Sort by Filename, then check the list for duplicates. Press the Zoom key (F8) to use the whole screen for the file list—that way, you can spot when the size and date, as well as the name, are identical. If you suspect that certain files exist in multiple

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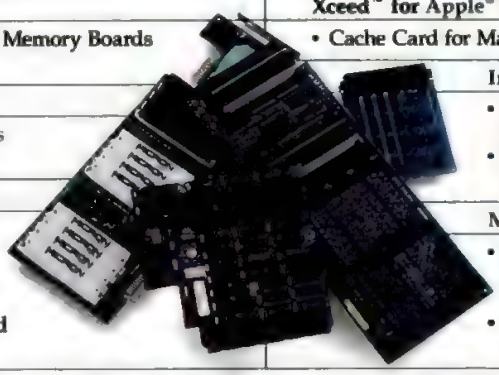

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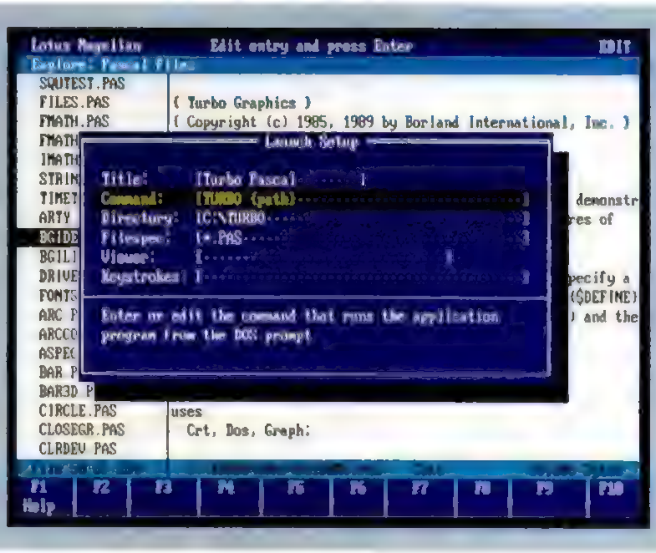


Figure 2: As symbolized here by {Path}, *Magellan* can pass the full pathname of the highlighted file when it launches an application.

copies, do a search with one such file as the criterion. *Magellan* will find any files that are similar to the file in question, and you can decide whether to keep them all.

THE SYSTEM BUILDER

Version 2.0 of *Magellan* lets you build menu systems by creating custom message and dialog boxes tied to macros. To create a custom dialog box, enter the necessary information in a format consisting of a header line (up to 50 characters); a blank line; and up to 14 choices in the following format:

- the option name (up to 60 characters),
- a blank line,
- one or two lines (each up to 60 characters) that describe the option,
- a blank line,
- a *Magellan* macro (up to 255 characters) to be executed when the user selects this option, and
- a blank line.

Figure 3 lists the program you might use to create a sample dialog box file with three options. Note the caret (^) in front of the *M* in *Magazine*. When *Magellan* displays the dialog box, it will highlight the *M*, and pressing M will instantly select that option.

Let's analyze the first macro entry. The {Explore} keyword has the same effect in *Magellan* as pressing the F9 key. It's better to use the keyword itself in macros, however, because you might have another *Magellan* macro that redefines the function key. {Choose}, followed by an option name and {Enter}, selects the named option from the current list. After choosing All files as our Explore Group, the character T puts us in the Text fill-in box, and the characters ="PC Magazine" go directly into the box. The two {Enter} codes begin the search.

The second macro entry is similar to the first, but the third calls up a custom message box, shown in Figure 4. A custom message box may contain up to 14 lines of no more than 60 characters each. The keywords

```
{Message}NOWAY.MSG{Enter}
```

display the custom message box. {KeyWait} waits for a keystroke from the user and does not pass that keystroke back to *Magellan*. After this,

```
{Dialog}MAGART.DLG{Enter}
```

brings up the dialog box again. The \025 characters in the last line of Figure 4 represent ASCII character 25, a downward-pointing arrow.

To "run" our dialog box, we need another *Magellan* macro. To create this macro, press the Macro key (Alt-F7), followed by N to define a new macro. Fill in the fields of the Macro Setup screen as shown in Figure 5. The resulting macro will invoke MAGART.DLG when Alt-M is pressed. Or, replace MAGART.DLG in the Keystrokes field with {Path}. Then highlight any *.DLG file and press Alt-M to run it.

You can assign a macro to any key, including those used by *Magellan*. If you redefine one of the function keys, the name in the function key map at the bottom of the screen will change to show the beginning of your macro's description. The Macro Learn function lets you record simple keystroke macros straight from the keyboard. To create macros that involve keywords, you must either type the macro into the Keystrokes field or store it in a file and put the filename, preceded by an @, in the Keystrokes field. In either case, the length of the macro cannot exceed 255 characters.

Here's a useful macro for quickly finding files that contain an exact match for a multiword phrase, such as *PC Magazine*. Although *Magellan*'s indexed search can find all files that contain both of the words, they won't necessarily be together as a phrase. The Mark (F3) command can do a nonindexed search for all files containing a particular text string, but it's much slower than an indexed search.

My Alt-E (E for Exact) macro, shown below, combines both methods to perform a search that's both quick and exact. Create it as you did the Alt-M macro above, but in the Keystrokes field type

```
{Explore}T{LineIn}{Enter}{Mark}T
{PgUp}{PgUp}{Enter}{Sort}M{Enter}
```

In the macro, the keywords

```
{Explore}T{LineIn}{Enter}
```

bring up the Explore dialog box, pause for you to enter the phrase, and perform an indexed search. The result is a list of files that contain all of the words from the

SAMPLE MAGELLAN DIALOG BOX

```
Find Magazine Articles

PC ^Magazine

Find articles from or
about PC Magazine

{Explore}{Choose}All files{Enter}T
="PC Magazine"{Enter}{Enter}

PC ^Computing

Find articles from or
about PC Computing

{Explore}{Choose}All files{Enter}T
="PC Computing"
{Enter}{Enter}

Mac^User

Find articles from or
about MacUser
{Message}NOWAY.MSG{Enter}{KeyWait}
{Dialog}MAGART.DLG{Enter}
```

Figure 3: With *Magellan* 2.0 you can create your own dialog boxes (user menus).

phrase. After this, the keywords

```
{Mark}T{PgUp}{PgUp}{Enter}
```

perform a nonindexed search on that list of files, using the phrase you entered before. Finally,

```
{Sort}M{Enter}
```

puts the marked files at the top of the list.

THE UTILITY COLLECTOR

Some folks collect utilities the way others collect baseball cards. They swap 'em and search for new ones to acquire the largest utilities collection. If this is your aim, you won't like *Magellan*, for it will render half your collection useless. But if you're more interested in quality than in quantity,

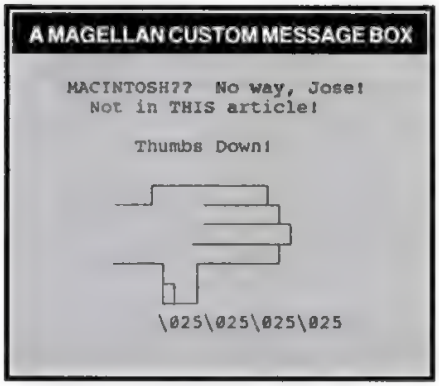


Figure 4: Add flair to your macros by using *Magellan* custom message boxes. Each box can have as many as 14 lines of 60 characters each.

you'll appreciate that *Magellan* is a one-program utilities compendium. It replaces

- DOS shells and directory managers;
- file browsers;
- file finders, such as WHEREIS.COM;
- RENDIR and any other directory renamers;
- PKZIP and PKUNZIP;
- PRUNE, KILLDIR, and any other utilities that chop a directory and all of its subdirectories from your directory tree;
- DIFF and any utilities that compare two text files and report all the differences;
- MOVEFILE utilities, for moving a file from one directory to another;
- File undeletion utilities;
- CRC (cyclic redundancy check) utilities that check your executable files to see if they've been modified;

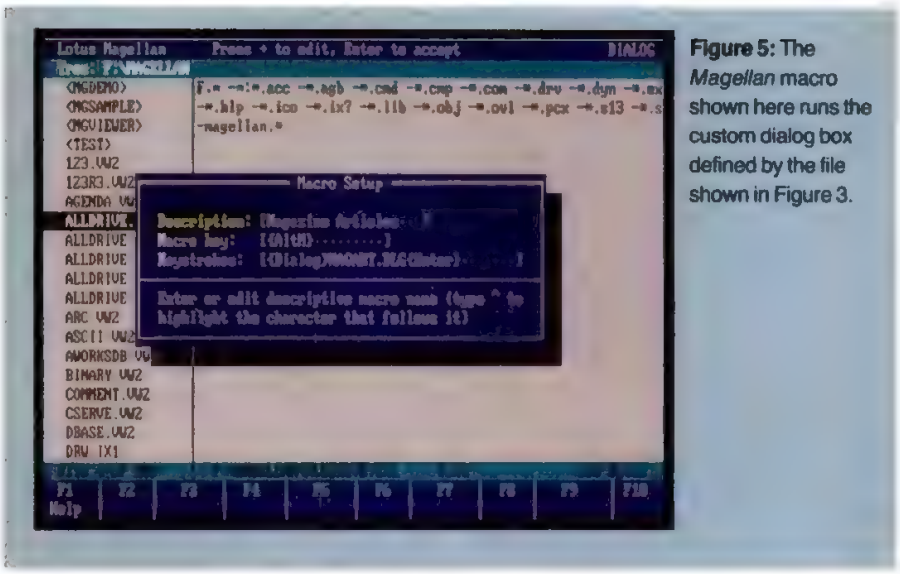


Figure 5: The *Magellan* macro shown here runs the custom dialog box defined by the file shown in Figure 3.

- Simple word processor conversion utilities, (in *Magellan* you can view the file with the "foreign" word processor's viewer and then Gather it to an ASCII text file).

THE FLOPPY DISK COLLECTOR

To speed its searches, *Magellan* can index any file on your system. What about files that are stored on floppy disks? You can create a *Magellan* index on a floppy, but that doesn't help when you don't know which disk to search. With the help of a little trick from *Magellan*'s author, however, you can keep the files on the floppies and index them on your hard disk.

First of all, create a directory called FLOPPY on your hard disk. (Ctrl-F9 is the MkDir key in *Magellan*.) To catalog a diskette, follow these steps:

- Create a subdirectory under the FLOPPY directory whose name matches the floppy disk's label.
- Copy the files from the floppy disk to this directory.
- Update your index—press Alt-F5 and select Update.

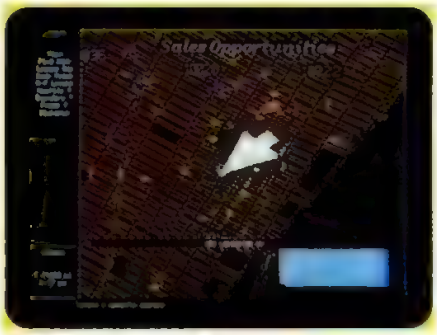
At this point, the files are on your hard disk and they're recorded in your index. Now comes the tricky part. Run the ZEROBYTE utility, which is available on CompuServe's LOTUSB Forum, Library 8, in the file ZROBYT.ARC. It will reduce the files to zero bytes without changing their date/time stamp. Since *Magellan* reindexes a file only when the date/time changes, even though the files are now empty, their index entries remain. The zero-byte files take no disk space except for the 32-byte directory entry.

ZIPNGO.BAT — COMPLETE LISTING

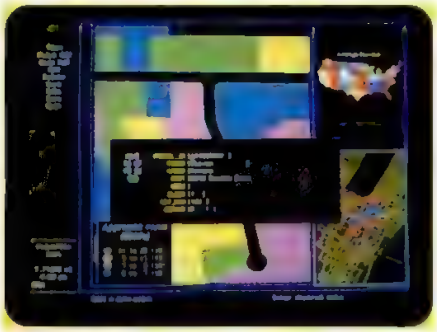
```
@ECHO OFF
IF "%3"==="" GOTO explain
MGUNZIP %1 %2 %3
IF ERRORLEVEL 1 GOTO UnzipTrouble
ECHO I have extracted "%3" from "%1".
ECHO To use this batch file, insert a line that
ECHO calls a program to work with "%3", e.g.
ECHO       WP %%3
PAUSE
MGZIP -a %1 %2%3
IF ERRORLEVEL 1 GOTO ZipTrouble
DEL %2%3 > NUL
GOTO end
:explain
ECHO Before invoking this Launch option, highlight the filename
ECHO within the ZIP file and press {Enter} to View it.
PAUSE
GOTO end
:UnzipTrouble
ECHO Sorry, I could not unzip the file for you.
PAUSE
GOTO end
:ZipTrouble
ECHO I could not re-ZIP the file %2%3, so I didn't delete it.
:end
```

Figure 6: This batch file lets *Magellan* launch an application that will modify a file stored inside a ZIP file. It then re-ZIPs the file after modification.

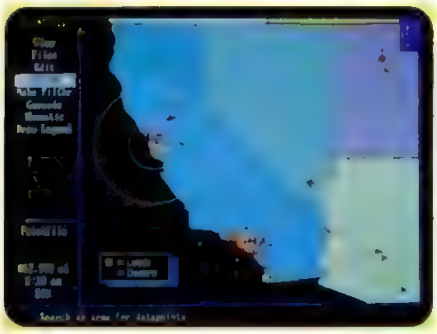
See Your Data*



MapInfo software can find, display and analyze your data geographically. See your prospects, customers, facilities —anything in your database. Find addresses by street, ZIP code, city, etc. (We can even supply the maps.*)



Any point or region on the map can have a complete record of data behind it. See your *actual* dBASE data in a window to view, edit, and print. Draw your own boundaries. Add titles and legends for high quality presentations.



Perform analyses on your data to sum, average, or count your database records by location. Color sales territories by volume of orders, ZIP codes by numbers of leads, countries by your demographic data.

From street-level to worldwide, MapInfo can merge your databases with maps. Play visual "what if" with your data. See patterns, trends, and opportunities you never knew existed. If you need to map your data, MapInfo can do it.

*MapInfo now has "TIGER," the most up-to-date and comprehensive library of street maps available on the PC. Prices vary. MapInfo comes with a map of the world and the U.S. with all ZIP code locations. Runs on IBM PCs or compatibles with 640K RAM, a hard drive, and graphics.

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CIRCLE 291 ON READER SERVICE CARD

Lab Notes

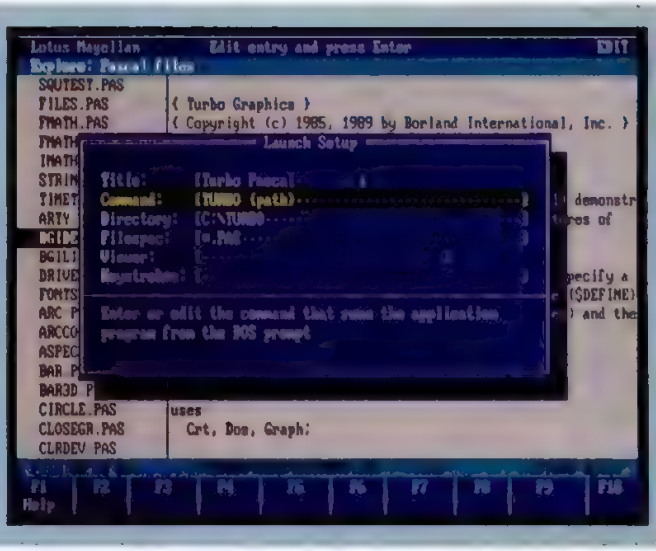

Figure 7: *Magellan* can pass information about a file to a program that is being launched. Here, *Magellan* passes on information about the *xxx* file to *yyy*, the program being launched.

Now create a *Magellan* file group, called Files on Floppies, using the path

```
C:\FLOPPY\**\*.*
```

The double asterisk represents one subdirectory level—only files in directories immediately below FLOPPY will be included. To locate a file stored on diskette, just explore this file group. When you find a file, look at the directory name to see which disk to insert—the ZEROBYTE file viewer will display the file from the disk.

If you simply Update your index periodically, you'll have no trouble fooling *Magellan* into maintaining such an index of files that aren't actually on your system any more. But if you have to Rebuild the index, it will reindex every file, and you'll lose your index of floppy disks. To avoid this possibility, you may want to index your floppy disks in a separate index file and keep a backup copy of that file.

THE SPACE-MISER

Since *Magellan* can index and display files inside a ZIP-compressed file, you might wish to save space by keeping all (or most) of your files ZIPed. This does create one problem, however: you can no longer Launch an application and auto-load one of the ZIPed files. Or can you?

The batch file ZIPNGO, shown in Figure 6, lets you extract a ZIPed file, call an application to act on it, and then re-ZIP the modified file. To install it, create a special Launch Option that calls the batch file. Figure 7 shows the Launch Setup for this option. The keywords in brackets become command-line parameters to the batch file. {Path} signifies the full pathname of the current file (the ZIP file), and {Disk} is the current drive (for example, C:). {Dir\}, the current directory, is terminated with a backslash. Most important, {EmbedFile} is the name of the embedded file that you are currently viewing.

When the batch file runs, it extracts the embedded file from the ZIP file, then calls the application of your choice to act on that file. After you close the application, the next command puts the modified file back into the ZIP. Finally, if all went well, the batch file deletes the extracted file.

> *Magellan* can index and display files that are stored within a ZIP-compressed file.

When the *Magellan*, Version 2.0, beta-test release first shipped, the {EmbedFile} keyword didn't exist. I asked the program's developers how to get access to the name of the highlighted file within a ZIP. Two days later a new version arrived at my front door with the new keyword. Now that's listening to your users! ■

Neil J. Rubenking is a contributing editor of PC Magazine.

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INTERGRAPH

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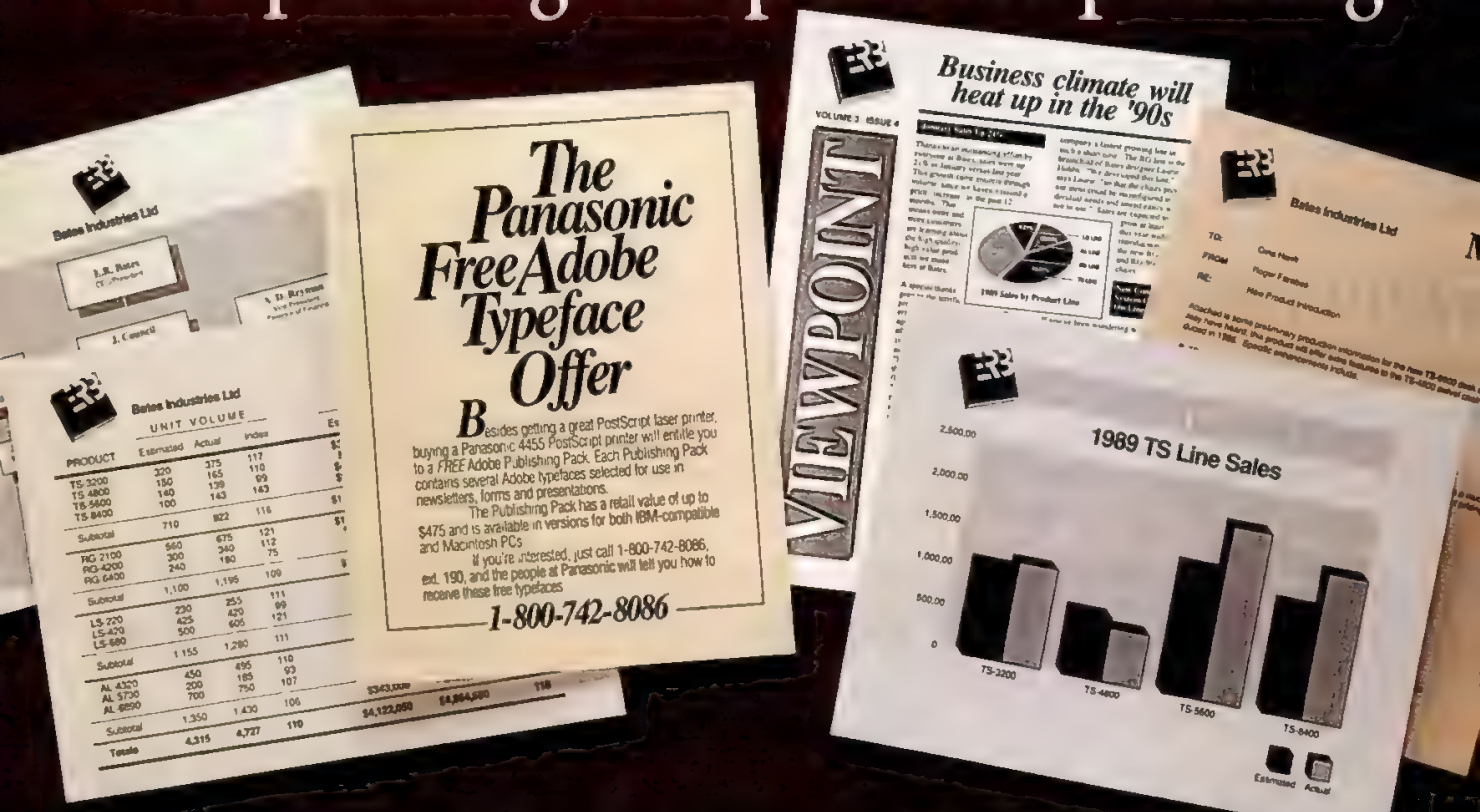

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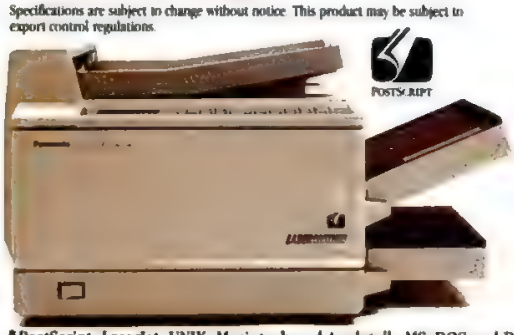

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LPS-PC

CIRCLE 138 ON READER SERVICE CARD

by
Douglas Boling

Utilities

Compile Your Batch Files for Added Speed With BAT2EXEC

Daily PC operations are practically unimaginable without the use of batch files. Everyone has his favorite collection of them, and some users have constructed complex batch files, thousands of bytes long, that push the batch language itself to its limits. Programs that expand the available batch file functions, such as Michael Mefford's BATCHMAN (*PC Magazine*, January 30, 1990), encourage users to make even larger batch files. BAT2EXEC.COM fully supports all the BATCHMAN extensions.

Unfortunately, however, batch files are also notoriously slow. It can be almost painful to watch them scroll down the screen a line at a time. A standard way to improve the speed of interpreted programs, like batch files, is to compile them. And that's where BAT2EXEC enters the picture.

BAT2EXEC is a batch language compiler. It reads your ASCII batch file and produces a .COM format program that performs the same function as the original batch file. Just as with the batch file, the resulting .COM program can execute DOS internal commands and execute other programs. Environment variables and command-line parameters are processed as they would be in the original. The two files differ mainly in that the resulting .COM program will execute much faster than the original .BAT file.

You can download a ready-to-run copy of BAT2EXEC.COM from PC MagNet. The source code (BAT2EXEC.ASM) and a BASIC program (BAT2EXEC.BAS) that will produce the executable file BAT2EXEC.COM are also available from PC MagNet. The downloading instructions are given in the sidebar "BAT2EXEC by Modem." BAT2EXEC.BAS is also printed here, in case you don't have a modem—but have the time and patience to key in this listing. Finally, if you're interested in assembling BAT2EXEC yourself from its .ASM listing, you'll need a macro assembler (IBM or Microsoft, Version 2 or later), and you should enter the following set of commands:

```
MASM BAT2EXEC;
LINK BAT2EXEC;
EXE2BIN BAT2EXEC BAT2EXEC.COM
```

To create the utility from its .BAS listing, just run BAT2EXEC.BAS in BASIC.

> ■ Large batch files often run annoyingly slowly. Compiling them with BAT2EXEC will increase both your productivity and satisfaction.

USING BAT2EXEC

The full syntax for BAT2EXEC could hardly be simpler. Just enter

```
BAT2EXEC FILE.BAT
```

where *FILE.BAT* is the name of your batch file. BAT2EXEC will then produce an executable .COM file with the name *FILE*.COM. If BAT2EXEC can't find the batch file, an error message will be printed. If BAT2EXEC can't understand a line in the batch file, it will print an error message indicating the line in the file in which it discovered the error.

BAT2EXEC should not be used on every batch file. AUTOEXEC.BAT, for example, *must* remain a genuine batch file in order for COMMAND.COM to find it. Similarly, batch files that run terminate-and-stay-resident utilities (TSRs) should not be compiled. The reason for this last limitation lies in the DOS memory management structure: if a TSR is executed from a program compiled by BAT2EXEC, the memory used by BAT2EXEC itself will not be made available to the system after it terminates.

COMPILED VS. INTERPRETED PROGRAMS

To understand what BAT2EXEC does, you must understand the differences between *interpreted* and *compiled* programs. Both types of programs start out as files written in a specific language, such as C, BASIC, or DOS's batch language, but that's where the similarity ends.

In an interpreted program, a separate program, called an *interpreter*, reads each line of the program and performs the instruction contained in that line. COMMAND.COM itself has a built-in interpreter that executes batch file programs. Thus, a program statement to print a line to the screen will be read and deciphered by the interpreter, after which the interpreter will print the line to the screen in the format specified by the print statement. Note that if a loop in the program causes the same line to be reexecuted, the line must again be read, deciphered, and the data printed from scratch.

One of the problems with interpreters, then, is that if a line is executed more than once, the same work of reading and deciphering must be performed again. Indeed, all the reading and deciphering interpreters must do takes as much time as performing the actual functions called for by the program.

Furthermore, even with a simple lan-

guage (such as the batch language) there is significant work just to determine the statement being executed. For example, for a batch file simply to run a program, the line must be scanned for redirection parameters, environment variables must be evaluated, and the program name must be compared with all possible internal commands. Only after all of this can the program be executed.

Of course, interpreted programs also have significant advantages. Their major plus is that they can be created and immediately executed. You can use a simple ASCII editor to create the program and then try it from the command line. In a short program the lack of execution speed is unimportant; it is the ease of creating and running the program that matters. Further, if there is an error in the batch file, the offending line can quickly be changed and the program run again.

Compilers are programs that turn an ASCII file written in a language into a standalone executable file. All the work involved in determining the function of each line is done when the program is initially compiled. The resulting program contains only the machine language instructions necessary to execute the program.

The advantages of compiled programs, then, are their speed and ability to run without the aid of an interpreter. Reverting to the example above of a line that prints a string to the screen, a compiler can simply create the few instructions necessary for the program to call the DOS print string command. If this section of code were executed again, only the specific call to DOS would be executed. Further (though this does not apply specifically to batch files, since they use COMMAND.COM for their interpreter), since compiled programs execute without the aid of an interpreter, you don't have to buy an interpreter just to run the program.

Using a compiler is not a panacea, however. Developing a program takes more time, since the program must be recompiled any time the original is changed. Compiled programs can be hard to debug, since the machine language output from the compiler can be cryptic.

The choice between using interpreted programs and compiled programs is usually decided on the basis of how the program will be used. For quick, simple programs, (such as small batch files) using an interpreter is best. For application programs or complex batch files, using a compiler is a better bet.

PC UTILITIES BY MODEM

The programs published in *PC Magazine* are available by modem from PC MagNet.

To join PC MagNet, set your communications software for either 300 or 1,200 bits per second, 7 data bits, even parity, 1 stop bit, and full duplex. To find the number nearest your dialing exchange, dial (800) 346-3247. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the number closest to you.

After you have found the phone number nearest you, hang up and redial using that number. When you connect with PC MagNet, press Ctrl-C. At the HOST NAME prompt, enter CIS. At the USER ID prompt, enter 177000,5000. Enter PC*MAGNET at the PASSWORD prompt and Z10D9014 at the ENTER AGREEMENT NUMBER prompt. For Customer Service, call (800) 848-8990; outside the United States, call (614) 457-8650.

To download BAT2COM.COM and/or its assembly language source listing and BASIC listing, log on to PC MagNet. Enter GO UTILITIES or choose PC MAGAZINE UTILITIES from the top menu, then DIRECT UTILITY DOWNLOAD from the next menu. Enter the filename, then select the file you want to download from those presented. Answer yes (Y) to DO YOU WISH TO DOWNLOAD? Press Enter to see the transfer protocols. Choose a protocol and download the file.

You don't have to be a member of CompuServe to access PC MagNet. It costs $12.80 an hour for 1,200/2,400-bps service and $6.30 for 300-bps, via MasterCard, VISA, or American Express. These programs can be copied but are copyrighted and are made available only for noncommercial use. You may make copies for others as long as no charge is involved, but making copies for any commercial purpose is prohibited.

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3
BEN51.EXE (PC Labs Benchmark Series, Release 5.1)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2 (the upgraded program now works with volumes greater than 32MB)
DIRMATCH.COM, Version 1.1
EMS40.SYS, Version 1.1 (fixes a problem with *Lotus 1-2-3*)
LITES.COM, Version 1.1
LOG.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
RN.COM, Version 2.0 (now works under DOS 4.*x*).
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT .ARC.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to June 1989. This easy-to-use database is a subset of the *Computer Library* Periodicals Database, which is available on CD-ROM and on PC MagNet. It requires the search files in PCSRCH.EXE.

PCSRCH.EXE is a self-extracting archive containing the software used to retrieve citations from the *PC Magazine* Reviews Index. Please read the information file PCM.INF before you download any of these files. ■

BAT2EXEC INTERNALS

The .COM file generated by BAT2EXEC consists of a series of calls to a set of predefined routines and a data area containing the data used by the routines. The predefined routines perform such standard functions as echoing a string to the screen, testing the condition of an IF statement, and executing another program. BAT2EXEC keeps track of which routines a program needs and includes only the necessary ones in the .COM file. This keeps the .COM file as small as possible.

Overall, BAT2EXEC can be viewed as two separate programs. The first part consists of the compiler code. The compiler parses each line of the batch file and produces the compiled version of the file. The rest of BAT2EXEC comprises a collection of routines that perform the functions needed by the resulting .COM file.

The batch file is compiled by determining what command is on each line and then calling the appropriate routine to parse that command. Individual routines within BAT2EXEC parse each of the batch commands. Additional routines process external programs, internal COMMAND .COM commands, and labels.

In general, each parsing routine must copy the necessary data into the data buffer, include any called routines, and insert the necessary in-line code to call the routines. The routines COPY_STRING, INLINE_CODE, and INCLUDE_CODE perform most of the necessary work.

COPY_STRING copies ASCII strings into the data buffer. This routine also returns a flag if any command-line parameters or environment variables are found. The length of the string is returned for routines (such as launch programs), that create a buffer of defined length.

The INCLUDE_CODE routine computes the runtime offsets of any of the canned routines required by the source program. If a canned routine calls other routines, INCLUDE_CODE recursively calls itself to include them, as well. Within BAT2EXEC, routines call each other by using a call table associated with the routine. Thus, when a routine is included into the .COM file, its call table is scanned to see whether the routine depends on any other routines. If other routines are needed, those routines are included. The runtime offsets of these routines are then loaded into the call table. To address the table, routines use the CALL instruction to push the starting address of the routine onto the stack. This address is popped into the BX register and used as an offset to the call table and any local data.

INCLUDE_CODE does not include the actual code for a routine; rather, it simply adds the routine to a list of routines to be included in the output file. After the source file has been parsed, the requisite individual routines are then assembled in the output file immediately following the setup code. Since the setup code and each of the individual canned routines has a defined length, the runtime offsets of the routines can be determined before the .COM file is built. This offset is what INCLUDE_CODE returns to the parsing routine.

INLINE_CODE generates the code necessary to call the included routines. The routine generates MOV, LEA, and MOV immediate opcodes for both SI and DI registers. Calls, jumps, and conditional jumps can be appended after the register loads. The code is generated by copying code fragments from BAT2EXEC into the code buffer. The opcodes are then modified to point to the proper offsets. The offset of the appropriate canned routine returned by INCLUDE_CODE is passed to INLINE_CODE where it is used as the offset for the call instruction.

BY WAY OF ILLUSTRATION . . .

Perhaps the best way to understand how BAT2EXEC works is to compare two programs: an actual batch file and the .COM file that BAT2EXEC creates from it. Figure 1 shows a simple .BAT file that echoes a line to the screen, copies a file (if it exists) to the A: drive, and echoes a line indicating that the program is finished. Error messages are included, and as with any good program, COPYFILE.BAT is well commented with REM statements.

Figure 2 shows a representation of the .COM file output produced by BAT2EXEC. Since COPYFILE.COM itself consists simply of machine code instructions, it would be nearly impossible to read, so I disassembled it to show the assembly language statements and added comments.

When the .BAT file is executed, COMMAND.COM reads it in, one line at a time. Each line is scanned for redirection characters, and then the first word in each line is read in order to determine the function of the line.

The ECHO statement prints a line to the screen, telling the user that the file will be copied. The first command-line parameter is substituted for %1 in the string.

The IF statement causes COMMAND .COM to check whether the file entered on the command line exists. This line illustrates how command-line parameters (and environment variables) can be used at almost any point in a batch file line. If the file exists, the second part of the line—in this case, the jump to label LABEL1—is executed.

The GOTO statement causes COMMAND.COM to jump to the label and

COPYFILE.BAT — **COMPLETE LISTING**

```
rem
rem This is an example BAT file that copies a file if it exists.
rem

echo File %1.asm will be copied to diskette A

rem
rem Check to see if the file exists.
rem
if exist %1.asm goto label1

rem
rem File not found, print error message and quit
rem
echo File %1.asm does not exist!
goto end

:label1
rem
rem Copy file
rem
copy %1.asm a:
:end
```

Figure 1: This illustrative batch file, which simply copies a file to a disk in Drive A:, is the source for the compiled version shown in Figure 2.

COPYFILE.ASM 1 of 3

```
;-----------------------------------------------------------------------
; COM program compiled by BAT2COM.
;-----------------------------------------------------------------------
                org     100h

init_code       proc    near
                assume  cs:code,ds:code,es:code,ss:code
                mov     bp,Data_ptr
                mov     sp,com_stack_ptr        ;Move stack pointer
                mov     bx,com_prog_size        ;Reduce memory allocation
                mov     ah,4ah                  ;Resize memory block
                int     21h
                mov     ax,ds:[2ch]             ;Get program environment seg
                mov     environment_seg,ax      ;  use unless SET cmd used.
                mov     bx,code_start_ptr
                jmp     bx                      ;Jump to start of code.
init_code       endp
;-----------------------------------------------------------------------
; Common data for all COM programs.
;-----------------------------------------------------------------------
code_start_ptr  dw      offset code_start
com_stack_ptr   dw      offset end_of_code + 512
com_prog_size   dw      (offset end_of_code+1031) SHR 4
com_label1_start dw     offset label1
string1_buff    dw      offset end_of_code + 514
string2_buff    dw      offset end_of_code + 768
string3_buff    dw      offset end_of_code + 1016
forloop_ptr     dw      0
stdout_hdl      dw      ?
outfile_hdl     dw      ?
stdin_hdl       dw      ?
infile_hdl      dw      ?
environment_seg dw      ?
dos_version     dw      ?
process_rc      db      ?
shift_count     db      0
;-----------------------------------------------------------------------
; Program specific data
;-----------------------------------------------------------------------
echo_string1    db      "File %1.asm will be copied to diskette A",0

exist_string    db      "%1.asm",0              ;String for EXIST test.

skip1_addr      dw      offset skip1            ;Offset of statment past GOTO

label1_struc    dw      offset end_struc - offset label1_struc
                dw      offset label1
                db      6
                db      "LABEL1"

echo_string2    db      "File %1.asm does not exist!",0

end_struc       dw      -1                      ;-1 = last label
                dw      offset end              ;offset in code to jmp
                db      3                       ;Length of label
                db      "END"                   ;ASCII label

internalcmd     db      14                      ;Length of internal cmd string
                db      "/C COPY %1.asm a:"     ;String to execute COPY cmd

;-----------------------------------------------------------------------
; Main code routine
;-----------------------------------------------------------------------
Code_start      proc    near
                lea     si,echo_string1         ;Translate string to include
                mov     di,string1_buff         ;  any command line parameters
                mov     ax,offset procstring
                call    ax
                mov     si,string1_buff         ;Echo string to screen
                mov     ax,offset echo_msg
                call    ax

                lea     si,exist_string
                mov     di,string1_buff
                mov     ax,offset procstring    ;Translate command line parm
                call    ax                      ;  for IF EXIST test
                mov     si,string1_buff
                mov     di,tempbuff2
                mov     ax,offset ifexiste      ;See if file exists
                call    ax
                jnb     continue
                jmp     [skip1_addr]
continue:
                mov     ax,[label1_struc+2]     ;Goto statment
                jmp     ax
skip1:
                lea     si,filenotfoundmsg      ;Translate command line param
                mov     di,string1_buff         ;  in echo string.
                mov     ax,offset procstring
                call    ax
                mov     si,string1_buff         ;Echo file not found msg
                mov     ax,offset echo_msg
                call    ax

                mov     ax,[end_struc+2]        ;Goto END statment
                jmp     ax
label1:
                lea     si,copycmdstring
                mov     di,string1_buff         ;Translate command line
                mov     ax,offset procstring    ;  parameter in copy cmd
                call    ax
                mov     si,string1_buff
                mov     ax,offset intcommand    ;Process Copy command
                call    ax
end:
                mov     ax,4c00h                ;Terminate program
                int     21h
code_start      endp

;-----------------------------------------------------------------------
; Subset of predefined routines needed for this COM file.
;-----------------------------------------------------------------------
;-----------------------------------------------------------------------
;ECHO MSG CODE Routine used print a string to the standard output device
; Entry:  DS:SI - offset of string to print.
;-----------------------------------------------------------------------
echo_msg_code   proc    near
                assume  cs:code,ds:code
                mov     dl,[si]                 ;Get character
                inc     si
                or      dl,dl
                je      echo_msg_1
                mov     ah,2                    ;Print character
                int     21h
                jmp     short echo_msg_code
echo_msg_1:
                ret
echo_msg_code   endp

;-----------------------------------------------------------------------
; SCAN_CHAR scans a string to find the first character.
; Entry:  SI - pointer to ASCII string
;         DL - 0 = find next char, 1 = find next space
;         CX - file length
; Exit:   AL - first nonspace character
;         CF - set if carriage return found
;-----------------------------------------------------------------------
scan_char       proc near
                assume  ds:nothing,es:nothing
scan_loop:
                lodsb
                cmp     al,9                    ;See if char is tab
                je      scan_space              ;If before, end of line
                cmp     al," "                  ;See if char is space.
                jb      scan_eol                ;If before, end of line
                je      scan_space
                or      dl,dl                   ;Not space, if looking
                jne     scan_loop               ;  for space continue.
                jmp     short scan_exit
scan_space:
                or      dl,dl                   ;Space found, see if looking
                je      scan_loop               ;  for one.
scan_exit:
                clc
                ret
scan_eol:
                stc
                ret
scan_char       endp

;-----------------------------------------------------------------------
; GETMEMBER  returns a pointer to the Nth word in a line.
; Entry:     SI - pointer to line of words
;            DH - number of the word to return
; Exit:      SI - pointer to word
;            CF - Set if word not in line.
;-----------------------------------------------------------------------
getmember_scan4 dw      offset scan4_next       ;Offset of called routine.

getmember       proc    near
                assume  cs:code,ds:code,es:code,ss:code
                push    bx
                call    getmember_0
getmember_0:
                pop     bx
getmember_1:
                xor     dl,dl
                call    getmember_scan4         ;Find next word
                jc      getmember_notfound
                dec     dh                      ;Dec parameter count
                jle     getmember_2
                inc     dl
                call    getmember_scan4         ;Find next space
                jc      getmember_exit
                jmp     short getmember_1       ;If not done, loop back.
getmember_2:
                dec     si                      ;Backup to 1st char in word.
                clc
getmember_exit:
                pop     bx
                ret
getmember_notfound:
                stc
                jmp     short getmember_exit
getmember       endp

;-----------------------------------------------------------------------
; PROCSTRING processes a string to convert any environment variables or
;            command line variables.
; Entry:  DS:SI - ASCIIZ string to process
;         ES:DI - pointer to output buffer.
; Exit:   DS:SI - pointer to beginning of new ASCIIZ string.
;        [SI-1] - Length of new string.
;-----------------------------------------------------------------------
procstr_cmdl    dw      offset subparm_next     ;Offset of called routines.
procstr_env     dw      offset subenv_next

procstr_code    proc    near
                assume  cs:code,ds:code,es:code
                push    bx
                call    procstr_0
procstr_0:
                pop     bx
                push    di
                push    si
                mov     ah,255                  ;Set size of buffer
procstr_1:
                lodsb                           ;Get byte from string
                or      al,al                   ;Check for end of string
                je      procstr_exit
                cmp     al,"%"                  ;See if special character
procstr_jmp:
                je      procstr_3               ;Yes, process special char.
procstr_2:
                stosb                           ;Store byte from string
                dec     ah
                jne     procstr_1
procstr_exit:
                xor     al,al                   ;Force zero byte end.
                stosb
                pop     si
```

Figure 2: Here, the .COM file generated by BAT2EXEC from the batch files shown in Figure 1 has been disassembled and commented for easier reading.

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COPYFILE.ASM 2 of 3

```
                pop     di
                mov     bl,255
                sub     bl,ah
                mov     ds:[di-1],bl            ;Store length of string
                pop     bx
                ret
;
;A percent sign has been found indicating a 'soft' parameter.  Three types of
;soft parameters are allowed; command line parameter, environment variable,
;and for loop parameter.
;
procstr_3:
                lodsb                           ;Get next character
                dec     cx
                cmp     al,"%"                  ;If double %, include one
                je      procstr_2               ;  in string.
                cmp     al,7fh                  ;See if for loop var
                jne     procstr_32
                push    si
                mov     si,forloop_ptr          ;Get ptr to for loop string
procstr_30:
                lodsb
                cmp     al,0                    ;If zero, end of string
                je      procstr_31
                stosb
                dec     ah                      ;Dec buffer size counter
                jne     procstr_30              ;If buffer not full, continue
procstr_31:
                pop     si                      ;Get back source string pointer
                jmp     short procstr_4
procstr_32:
                mov     dh,al                   ;Copy and check to see if
                sub     dh,"0"                  ;  the next char is a number.
                jb      procstr_5               ;  If so, assume a line
                cmp     dh,9                    ;  parameter.
                ja      procstr_5
                call    procstr_cmdl            ;Call cmd line param routine
procstr_4:
                or      ah,ah
                jne     procstr_1
                jmp     short procstr_exit      ;If at end of string, done
procstr_5:
                dec     si                      ;Backup to 1st character
                inc     cx
                call    procstr_env
                jmp     short procstr_4
procstr_code    endp

;-----------------------------------------------------------------------
; SUBLINEPARAM substitutes a parameter from the command line.
; Entry:  ES:DI - pointer to buffer to copy the line parameter
;            DH - binary number of the line parameter
;            AH - size of buffer
; Exit:   ES:DI - pointer to byte after the parameter in the buffer
;            CX - remaining length of the buffer
;-----------------------------------------------------------------------
subparm_getmem  dw      offset getmember_next   ;Offset of called routine.

sublineparam    proc    near
                assume  cs:code,ds:code,es:code,ss:code
                push    bx
                call    sublineparam_1
sublineparam_1:
                pop     bx
                push    cx
                push    si
                push    ds
                mov     si,80h                  ;Get ptr to cmd line
                xor     cx,cx
                mov     cl,[si]                 ;Get number of chars in buffer.
                inc     si                      ;Point to data
                add     dh,ds:shift_count       ;Add in shift count.
                or      dh,dh                   ;Check count of param to find.
                jnz     sublineparam_11
sublineparam_11:
                call    subparm_getmem          ;Get pointer to proper word.
                jc      sublineparam_exit
sublineparam_2:
                lodsb                           ;Get character from parameter
                cmp     al," "                  ;If space, parameter done
                jbe     sublineparam_exit
                stosb
                dec     ah                      ;Dec buffer size counter
                jnz     sublineparam_2
sublineparam_exit:
                pop     ds
                pop     si
                pop     cx
                pop     bx
                ret
sublineparam    endp

;-----------------------------------------------------------------------
; INTCMD  Launches the shell, usually COMMAND.COM, to run an internal command.
; Entry   DS:SI - pointer to the ASCIIZ internal command to run.
;-----------------------------------------------------------------------
intcmd_launch   dw      offset launch_next      ;Call to load and run program.
intcmd_getcom   dw      offset getcom_next      ;Call to find shell name.

intcommand      proc    near
                assume  cs:code,ds:code,es:code,ss:code
                push    bx
                call    intcmd_1
intcmd_1:
                pop     bx                      ;Get pointer to sub calls.
                mov     di,si                   ;Copy ptr to command
                dec     di                      ;Back up to cmd line size.
                push    ds
                call    intcmd_getcom           ;Get comspec string.
                call    ca:intcmd_launch        ;Run program.
                pop     ds
                pop     bx
                ret
intcommand      endp

;-----------------------------------------------------------------------
; GETCOMSPEC  Gets the name of the shell program running
; Exit:   DS:SI - pointer to the ASCIIZ name of the shell porgram.
;-----------------------------------------------------------------------

getcom_srchenv  dw      offset searchenv_next   ;Call to search environment blk

getcomspec      proc    near
                assume  cs:code,ds:code,es:code,ss:code
                push    bx
                call    getcom_1
getcom_str      db      "COMSPEC"
getcom_1:
                pop     bx
                mov     dx,offset getcom_1 - offset getcom_str
                mov     si,bx
                call    getcom_srchenv          ;Get pointer to comspec string
                pop     bx
                ret
getcomspec      endp

;-----------------------------------------------------------------------
;LAUNCH PROG  Routine used to load and run programs.
; Entry   DS:SI - pointer to the program name to run.
;         ES:DI - pointer to the command line tail.
; Exit    return code variable set.
;-----------------------------------------------------------------------
launch_fcb      equ     [bx]

launch_code     proc    near
                assume  cs:code,ss:code
                push    bx
                call    launch_1                ;Push IP on stack
                db      0                       ;Dummy FCB for program
                db      "DUMMY   FCB"
                db      0,0,0,0
launch_1:
                pop     bx                      ;Get pointer to local vars.

                push    ss
                push    ss                      ;Save stack ptr since it is not
                mov     com_stack_ptr,sp        ;  saved under DOS 2.x.

                push    cs                      ;Create Parameter block on
                lea     dx,launch_fcb           ;  the stack.  Start with 2nd
                push    dx                      ;  FCB.
                push    cs                      ;Push ptr to 1st FCB
                push    dx
                push    cs                      ;Push ptr to command line tail.
                push    di
                xor     ax,ax                   ;Use parent env block.
                push    ax
                mov     bx,sp                   ;Copy pointer to parameter blk

                mov     ax,4b00h                ;DOS EXEC program.
                mov     dx,si                   ;Get pointer to filename
                int     21h
                mov     bp,offset data_start_ptr - offset init_code + 100h
                mov     bp,cs:[bp]
                mov     bx,cs                   ;Reload SP to access local data
                cli
                mov     ss,bx                   ;Restore stack
                mov     sp,com_stack_ptr
                sti
                pop     ss
                pop     ds
;Get return code
                mov     ah,4dh                  ;Get return code
                int     21h
                mov     process_rc,al           ;Save
                pop     bx
                ret
launch_code     endp

;-----------------------------------------------------------------------
;GOTO  Routine to jump to a label pointed to by a cmd line parameter or
;      environment variable.
; Entry   DS:SI - pointer to label to find.
; Exit    This routine does not return unless the label is not found.
;-----------------------------------------------------------------------
goto_echomsg    dw      echo_msg_next           ;Used to print error msg
goto_lblsrch    dw      lblsrch_next            ;Used to find label

goto_code       proc    near
                assume  cs:code,ds:code
                call    goto_1
                db      8 dup (" ")
                db      " Label not found",13,10,$
goto_1:
                pop     bx
                mov     di,bx                   ;Load label into error msg
                xor     dx,dx                   ;Get size of label as it is
                mov     cx,8                    ;  copied into error msg.
goto_2:
                lodsb
                cmp     al," "
                jbe     goto_4
                cmp     al,'a'
                jb      goto_3
                and     al,0dfh                 ;Capitalize label
                cmp     al,'Z'
                ja      goto_4
goto_3:
                stosb
                inc     dx
                loop    goto_2
goto_4:
                mov     cx,dx                   ;Get size of label
                mov     si,bx                   ;Get pointer to label
                mov     di,com_label_start      ;Get ptr to start of label list
                add     di,bp                   ;Add offset of data
                push    bx                      ;Save ptr to msg
                call    goto_lblsrch            ;Call search routine
                pop     si
```

COPYFILE.ASM 3 of 3

```
                jc      goto_5                  ;CF set, label not found.
                pop     ax                      ;Remove return address
                push    [bx+2]                  ;Push new return address
                ret
;[illegible]:
                mov     bx,si                   ;Set addressability to call
                call    goto_echomsg            ;Print error message.
                ret
;[illegible] code    endp

;-----------------------------------------------------------------------
; [illegible] determines if a file exists.
; Entry: [illegible] - Pointer to ASCII filename.
;        DI - Pointer to buffer for disk transfer area.
; Exit:  CF - Clear if file exists
;        SI - If file exists, points to filename.
;-----------------------------------------------------------------------
```

```
.[illegible]    proc    near
                assume  cs:code,ds:code,es:code,ss:code
                mov     dx,di
                mov     ah,1ah                  ;Set DTA
                int     21h

                mov     dx,si                   ;Copy pointer to filename
                xor     cx,cx                   ;Normal attributes
                mov     ah,4eh                  ;DOS Find First
                int     21h
                jc      ifexist_exit
                add     di,1eh                  ;Point DI to filename in DTA
                clc
.ifexist_exit:
                ret
.[illegible]    endp
[illegible] code    e       $
```

continue execution from there. Labels present a problem for batch files; for since the COMMAND.COM interpreter does not know where the label is, the entire batch file must always be reread from the first line until the label is found. This search is one of the big reasons batch files are so slow.

The COPY function executes just as it would in a batch file, for here COMMAND.COM has the advantage of using one of its own internal functions. Another type of compiled program would need to implement its own copy function or call COMMAND.COM to perform the copy for it.

The BAT2EXEC-generated .COM file performs the same echo, test, and copy functions as would the batch file. In contrast to operation of the .BAT file, however, the .COM file is loaded into memory and executed by COMMAND.COM. The .COM file does not need COMMAND .COM to interpret each line, since it has been transformed (compiled) into machine language by BAT2EXEC.

The .COM file starts off by setting up its runtime environment. First, the BP register is loaded with the starting offset of the .COM file data area. The stack pointer is relocated to an area just above the end of the code and the memory allocation is reduced to the minimum needed by the program.

BAT2EXEC performs this setup on all programs it compiles, regardless of their contents. While some parts of the setup procedure are not always needed, creating a known environment for every program allows all the individual routines to be written with this environment in mind.

The program jumps to the main routine after completing the initial setup. The main routine simply calls each canned routine needed to execute the program properly. After all the requisite routines have been called, the program terminates. The compiled program is efficient because each line does not have to be interpreted (and sometimes reinterpreted) to determine its function, since this was done by BAT2EXEC at compile time.

The first routine called by the main routine is a procedure that translates any ASCII string containing command-line parameters or environment variables into pure ASCII strings. This routine is called with SI pointing to the ASCII data and DI pointing to one of three temporary buffers located beyond the code. The ECHO_MSG routine prints the string to the screen.

> BAT2EXEC consists of compiler code and routines that perform functions needed by the resulting .COM file.

The TRANSLATE routine is included in the code of Figure 2 because BAT2EXEC detected the command-line parameter %1 in the echo string of the batch file (Figure 1). If the string had not contained any command-line parameters (or environment variables), the call to the TRANSLATE routine would not have been included.

The call to the IF EXIST routine is similar to the ECHO statement call except for the conditional jump after the call. Since the filename to test contains a command-line parameter, a call is made to the translate routine, as before. Three separate routines are used for the IF statement, depending on the test to be performed. If the test fails, the program jumps past the code to implement the rest of the line.

Labels, while they do not introduce any code, do have an impact on the program compiled by BAT2EXEC. All labels in the program are organized into a linked list of structures, and a pointer to the start of this list is located in the global data section of the .COM file. The structure for each label contains a pointer to the next structure (the ASCII label and its length) and a pointer to the offset in the code at which the label occurred.

The GOTO code comes in two flavors. If the line has no replaceable parameters, a simple JMP instruction is placed in the main routine. If the goto contains an environment variable, however, a routine is called to scan the label list. Note that this search is much faster than COMMAND .COM's label search, since all labels in the program are tied together by the links in the list. When the label is found, the routine replaces the return address on the stack with the new destination read from the label structure. If the label is not found, a message is printed and the routine returns.

To execute the internal command COPY, BAT2EXEC executes a copy of COMMAND.COM with the command line pointing to the command to execute. COMMAND.COM's /C switch is used to execute the command and return. The routine for executing COMMAND.COM is quite simple. First, the environment is searched for the COMSPEC string, then the launch routine is called to execute the program pointed to by the COMSPEC variable.

The launch routine uses the DOS EXEC (function 4Bh) to load and execute a program. Before the program can be executed, the parameter block necessary for EXEC is created and all necessary regis-

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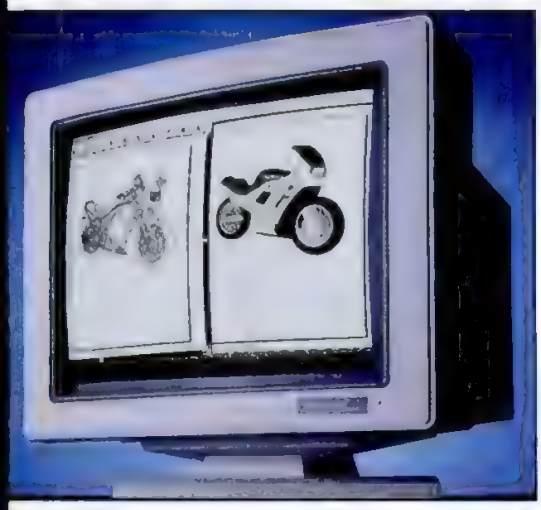

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BAT2EXEC.BAS 1 of 2

```
100 REM - BASIC PROGRAM TO CREATE BAT2EXEC.COM
110 CLS:PRINT "Creating BAT2EXEC.COM": OPEN "BAT2EXEC.COM" AS #1 LEN = 1
120 FIELD #1, 1 AS A$: CHECKSUM#=0
130 FOR I = 1 TO   350
140  LINESUM#=0: LOCATE 2,3: PRINT "Countdown: "   350 - I ;
150  FOR J = 1 TO  16: READ BYTE$: BYTE = VAL("&H" + BYTE$)
160   CHECKSUM# = CHECKSUM# + BYTE: LINESUM# = LINESUM# + BYTE
170   IF (BYTE < 256) THEN LSET A$=CHR$(BYTE): PUT #1
180  NEXT J
190  READ LINETOT$: LINECHECK# = VAL("&H"+LINETOT$)
200  IF LINECHECK# = LINESUM# THEN GOTO 220
210  LOCATE 4,2: PRINT "Error in line #"  ;  260 +  10 * I: GOTO 260
220 NEXT I
230 CLOSE: READ FILETOT$ : FILECHECK# = VAL(FILETOT$)
240 IF CHECKSUM# <> FILECHECK# THEN GOTO 260
250 PRINT: PRINT "BAT2EXEC.COM created successfully": SYSTEM
260 PRINT: PRINT "BAT2EXEC.COM is not valid!": END
270 DATA E9, C6,  2,  D,  A, 42, 41, 54, 32, 43, 4F, 4D, 20, 31, 2E, 30,   45F
280 DATA 20, 20, 63, 29, 20, 31, 39, 39, 30, 20, 5A, 69, 66, 66, 20, 43,   3D9
290 DATA 6F, 6D, 6D, 75, 6E, 69, 63, 61, 74, 69, 6F, 6E, 73, 20, 43, 6F,   658
300 DATA 2E,  A,  D, 58, 43, 20, 4D, 61, 67, 61, 7A, 69, 6E, 65, 20, FE,   542
310 DATA 20, 44, 6F, 75, 67, 6C, 61, 73, 20, 42, 6F, 6C, 69, 6E, 67,  A,   574
320 DATA  D, 24, 1A,  8,  1,  8,  8, 49, 46,  8, 52, 45, 4D,  8, 46, 4F,   254
330 DATA 52,  8, 45, 43, 48, 4F,  8, 47, 4F, 54, 4F,  8, 45, 58, 49, 54,   3E4
340 DATA  8, 50, 41, 55, 53, 45,  8, 53, 48, 49, 46, 54,  8, 53, 45, 54,   3E0
350 DATA  8, 43, 41, 4C, 4C,  8, 58, 41, 54, 48,  8, 58, 52, 4F, 4D, 58,   3D7
360 DATA 54,  8, 43, 44,  8, 4D, 44,  8, 52, 44,  8, 43, 4C, 53,  8, 44,   328
370 DATA 49, 52,  8, 44, 45, 4C,  8, 52, 45, 4E,  8, 56, 45, 52,  8, 56,   398
380 DATA 4F, 4C,  8, 43, 54, 54, 59,  8, 43, 48, 43, 58,  8, 54, 59, 58,   3FA
390 DATA 45,  8, 43, 4F, 50, 59,  8, 44, 41, 54, 45,  8, 54, 49, 4D, 45,   3CD
400 DATA  8, 45, 52, 41, 53, 45,  8, 43, 48, 44, 49, 52,  8, 4D, 4B, 44,   3B6
410 DATA 49, 52,  8, 52, 4D, 44, 49, 52,  8, 42, 52, 45, 41, 4B,  8, 52,   3D8
420 DATA 45, 4E, 41, 4D, 45,  8, 44, 45, 4C, 45, 54, 45,  8, 56, 45, 52,   406
430 DATA 49, 46, 59,  8, 43, 4F, 4D, 4D, 41, 4E, 44,  8,  8, CE,  7, 4A,   486
440 DATA  C, 24,  9, B9,  B, 16,  A, 4A,  C, 24,  C, 37,  C, 80,  B, 3B,   2AC
450 DATA  B, 80,  B, 80,  B, 3B,  B, EE,  A, 99,  A, 45, 52, 52, 4F, 52,   48C
460 DATA 4C, 45, 56, 45, 4C, 45, 58, 49, 53, 54, 2F, 43, 20,  8,  8,  8,   397
470 DATA  8,  8, EE,  E,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8, FF, FF,   2FA
480 DATA  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,  8,     8
490 DATA  8,  8, 54, 5E, 4D, 5E, 50, 5F, 24, 31, 2E, 21, 21, 21,  8,  8,   2F2
500 DATA  8, 54, 5E, 4D, 5E, 50, 5F, 24, 32, 2E, 21, 21, 21,  8, DC, 18,   3E7
510 DATA  8, 40,  8,  8,  8,  8,  8, 2E, 43, 4F, 4D,  8, 20, 20, 20, 20,   1AD
520 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 20,  D,  A, 45, 72, 72, 6F,   2EF
530 DATA 72, 20, 69, 6E, 20, 6C, 69, 6E, 65, 20, 24, 4E, 65, 65, 64, 20,   511
540 DATA 44, 4F, 53, 20, 32, 2E, 30, 20, 6F, 72, 20, 67, 72, 65, 61, 74,   4CA
550 DATA 65, 72, 24,  D,  A, 53, 79, 6E, 74, 61, 78, 3A, 20, 42, 41, 54,   4CA
560 DATA 32, 43, 4F, 4D, 20, 5B, 66, 69, 6C, 65, 6E, 61, 6D, 65, 5D,  D,   537
570 DATA  A, 24, 43, 61, 6E, 27, 74, 20, 66, 69, 6C, 64, 20, 69, 6E, 70,   5B3
580 DATA 75, 74, 20, 66, 69, 6C, 65, 24, 4E, 6F, 74, 20, 65, 6E, 6F, 75,   5D5
590 DATA 67, 68, 20, 6D, 65, 6D, 6F, 72, 79, 24, 4E, 6F, 20, 69, 6E, 70,   5D8
600 DATA 75, 74, 20, 66, 69, 6C, 65, 20, 73, 70, 65, 63, 69, 66, 69, 65,   611
610 DATA 64, 24, 43, 4F, 4D, 20, 66, 69, 6C, 65, 20, 73, 69, 7A, 65, 20,   522
620 DATA 74, 6F, 6F, 20, 62, 69, 67, 24, 53, 79, 6E, 74, 61, 78, 20, 65,   5D4
630 DATA 72, 72, 6F, 72, 24, 43, 6F, 6D, 70, 69, 6C, 65, 72, 20, 64, 61,   689
640 DATA 74, 61, 20, 62, 75, 66, 66, 65, 72, 20, 66, 75, 6C, 6C, 24, 4C,   5B2
650 DATA 61, 62, 65, 6C, 20, 64, 65, 66, 69, 6E, 65, 64, 20, 6D, 6F, 72,   5F1
660 DATA 65, 20, 74, 68, 61, 6E, 20, 6F, 6E, 63, 65, 24, 4C, 61, 62, 65,   58D
670 DATA 6C, 20, 20, 20, 20, 20, 20, 20, 20, 20, 6E, 6F, 74, 20, 66, 6F,   3D2
680 DATA 75, 6E, 64, 24, 49, 6C, 6C, 65, 67, 61, 6C, 20, 64, 69, 73, 6B,   5F8
690 DATA 20, 73, 70, 65, 63, 69, 66, 69, 65, 64, 24, 46, 4F, 52, 20, 6C,   563
700 DATA 6F, 6F, 70, 73, 20, 63, 61, 6E, 6E, 6F, 74, 20, 62, 65, 20, 6E,   5D9
710 DATA 65, 73, 74, 65, 64, 24,  D,  A, 24, BA,  3,  1, B4,  9, CD, 21,   4DD
720 DATA FC, B4, 30, CD, 21, 86, C4, BA, AB,  2, 80, FC,  2, 72, 50, BC,   87B
730 DATA DC, 18, B4, 4A, BB,  8, 18, CD, 21, A1, 7E,  2,  3,  6, 80,  2,   557
740 DATA A3, 4A,  2, B4, 48, BB,  8, 18, CD, 21, BA, F8,  2, 72, 30, A3,   69D
750 DATA 48,  2, B4, 48, BB,  8, 18, CD, 21, 72, 24, A3, 52,  2, BE, 80,   5CA
760 DATA  0, 33, C9,  A,  C, 74, 1B, 46, 32, DB, E0, 55,  A, 72, 13, 8A,   54A
770 DATA  4, 3C, 2F, 74,  7, E8, D3,  9, 72,  5, EB,  6, BA, E2,  2, E9,   69D
780 DATA 5A,  1, 8B, 36, 7E,  2, 8B, 3E, 4A,  2, 81, C7, 1E,  8, FF,  6,   51C
790 DATA 86,  2, A0, 55,  1, A2, 56,  1, 32, DB, E8, 31,  A, 73,  6, 3C,   55C
800 DATA  D, 74, EB, EB, 18, E8, 66,  2, 80, 3C, 40, 75,  6, C6,  6, 56,   658
810 DATA  1,  0, 46, EB, 4A,  1, 72,  2, EB, D4, E9, 1F,  1, E0, E3,  1,   682
820 DATA 89, 3E, 4C,  2, C4, 3E, 46,  2, BE, 1B,  F, B9,  5,  0, F3, A4,   59C
830 DATA 89, 3E, 46,  2, C4, 3E, 50,  2, BE, EE,  E, 8B, 4C, FE, FF, 34,   725
840 DATA 83, C6,  4, F3, A4, 5E,  B, F6, 75, F1, BD, 1F,  0, 8B,  0,  1,   73E
850 DATA  3, C7, 26, 89, 46,  8, 0B, EF, 8B, 36, 4A,  2, 8B,  E, 4C,  2,   52D
860 DATA 2B, CE,  3, C1, BB, 4E,  2, 8B, 17,  3, D3, 83, 3F, FF, 74, 24,   699
870 DATA  3, 1F, 83, 7F,  2, FF, 74,  5,  1, 47,  2, EB, EE, 8B, F3, 83,   6C2
880 DATA C6,  5, 33, C9, 8A, 4F,  4,  E,  7, BF, 82,  3, F3, A4, BA, 7C,   6CA
890 DATA  3, E9, AB,  8, F3, A4, 2B, 16, 4A,  2, 26, 89, 96, 16,  8, B8,   5CB
900 DATA  8,  1,  3, C7, 26, 89, 86,  8,  8, 0B,  E, 46,  2, 8B, 36, 44,   3E6
910 DATA  2, 8E, 1E, 48,  2, 2B, CE,  3, C1, 73,  6, BA, 22,  3, EB, 7C,   574
920 DATA 90, F3, A4,  E, 1F,  5,  0,  2, 72, F1, 25, FE, FF, 26, 89, 86,   715
930 DATA  2,  8,  5,  2,  0, 26, 89, 06,  6,  8,  5,  2,  1, 72, DC, 26,   2C8
940 DATA 89, 86,  8,  8,  5,  2,  1, 72, D2, 26, 89, 06,  A,  8,  5,  0,   3A7
950 DATA  1, 72, C8, 09, 3E, 54,  2,  5,  F,  8, 72,  F, B1,  4, D3, E8,   55D
960 DATA 26, 89, 86,  4,  8, 26, C6, 86, 1D,  8,  8, B4, 3C, 33, C9, BA,   56E
970 DATA 8D,  2, CD, 21, 8B, DB, B4, 48, 1E, C5, 16, 50,  2, 2E, 8B,  E,   5E6
980 DATA 54,  2, 2B, CA, CD, 21, 1F, B4, 3E, CD, 21, 32, C8, 50, B4, 49,   677
990 DATA 2E, 8E,  6, 48,  2, CD, 21, 58, B4, 4C, CD, 21,  E, 1F, 03, 3E,   52E
1000 DATA 86,  2,  0, 74, 14, 52, BA, 9A,  2, E8, 26,  8, A1, 86,  2, E8,   5DD
1010 DATA 33,  8, BA, C6,  3, E8, 1E,  8, 5A, E8, 1D,  8, B8,  1, EB, CD,   696
1020 DATA BB,  E,  0, BA,  4, 3C, 3A, 74, 21, BB,  C,  0,  3C, 25, 74, 1A,   418
1030 DATA 0B, 44,  1,  3C, 3A, 75,  8, 0B,  C,  8, 0B, FC, 20, 76,  B, E8,   58F
1040 DATA 55,  8, 57, BF, 57,  1, E8, 19,  8, 5F, 53, 83, FB,  8, 77,  8,   57B
1050 DATA B3,  1, E8, 99,  8, 73,  1, 4E, 5B, D1, E3, 81, C3,  0,  2,  F,   760
1060 DATA 17, C3, 51,  6,  E,  7, 8B, D1, 33, DB, 56, 8B, CA, F3, A6, 5E,   752
1070 DATA 74, 1A, 43, 32, C0, 38, 45, FF, 75,  1, 4F, B9,  A,  8, F2, AE,   667
1080 DATA 80, 3D,  8, 75, E5, BB,  D,  8, F9,  7, 59, C3, 83, FB,  C, 72,   6F7
1090 DATA  3, BB,  C,  8, F8, EB, F2, 57, 56,  6, 1E,  7, 8B, FE, 33, C9,   6FC
1100 DATA AC, 3C, 30, 72, 1A, 3C, 39, 76, 12, 3C, 41, 72, 12, 3C, 5A, 76,   4AE
1110 DATA  A, 3C, 61, 72,  A, 3C, 7A, 77,  6, 24, DF, AA, 41, EB, E1,  7,   617
1120 DATA 5E, 5F, C3, 8B, 3E, 57,  2,  8, 74, 18, C6,  6, 57,  2,  0, BB,   4FB
1130 DATA AE, 16, E0, 1B,  7, 33, C9, E0, 38,  6, 80, 3E, 50,  2,  0, 74,   57C
1140 DATA 10, C6,  6, 50,  2,  0, BB, 5D, 16, E8,  4,  7, 33, C9, E8, 21,   55C
1150 DATA  6, 80, 3E, 5C,  2,  0, 74, 15, 8B, 16, 5A,  2, B9,  1,  0, BB,   41D
1160 DATA D8, 16, E8, EB,  6, E8,  A,  6, C6,  6, 5C,  2,  0, 80, 3E, 5F,   5FE
1170 DATA  2,  0, 74, 19, 8B, 16, 5D,  2, 33, DB, 33, C8, E8, EB,  0,  6,   629
1180 DATA  6, 5C,  2,  1, C6,  6, 5F,  2,  0, 89, 16, 5A,  2, C3, 56, E8,   4BE
1190 DATA 91, FF, C6,  6, 56,  2,  0, 8B, EE, AC, 3C, 22, 75,  4, F6, 16,   6BC
1200 DATA 56,  2, 80, 3E, 56,  2,  0, 75, 15, 3C, 7C, 75, 48, C6, 44, FF,   56E
1210 DATA  D, 8B, 60,  2, 80, 3E, 59,  2,  0, 75,  3, BB, 6F,  2, F6, 16,   4F3
1220 DATA 59,  2, 33, D2,  8, 17, 75, 13, 8B, D7, 2B, 16, 4A,  2, 89, 17,   499
1230 DATA 8D, 77,  2, B4,  1, E0, 4E,  5, 32, C0, AA, 89, 16, 5D,  2, C6,   656
1240 DATA  6, 5F,  2,  1, 33, DB, 33, C8, E8, 56,  0, EB, 51, 3C, 3E, 75,   5D2
1250 DATA 26, 33, DB, 80, 3C, 3E, 75,  2, AC, 43, 53, 32, DB, E8, 4E,  7,   631
1260 DATA 8B, D7, B4,  1, E0, 1F,  5, 32, C0, AA, 2B, 16, 4A,  2, 58, E8,   68C
1270 DATA 2F,  0, E8, 7C,  0, EB, 88, 3C, 3C, 75, 1C, 32, DB, E8, 2E,  7,   631
1280 DATA 8B, D7, B4,  1, E0, FF,  4, 32, C0, AA, 2B, 16, 4A,  2, E8, 39,   74C
1290 DATA  0, E8, 5D,  0, E9, 60, FF, 3C,  D, 74,  3, E9, 59, FF, F8, 5E,   7E4
1300 DATA C3, 56, 50, B9, 31,  0,  B, DB, 74,  F, BB,  0, 10, E8,  0,  6,   575
1310 DATA BB,  6,  0, B9, 32,  0, E8, 19,  5, BB, 14, 16, E8, F1,  5, 5B,   5D0
1320 DATA E8,  F,  5, C6,  6, 50,  2,  1, 5E, C3, 56, B9,  1,  0,  B, DB,   53A
1330 DATA 74,  F, BB,  0, 10, E8, D8,  5, BB,  6,  0, B9,  2,  0, E8, F1,   668
1340 DATA  4, BB, 80, 16, E8, C9,  5, E8, E8,  4, C6,  6, 57,  2,  1, 5E,   663
1350 DATA C3, 57, 80, 20, 8B, FD, 4E, AA, 3B, FE, 72, F8, 5F, C3, 32, DB,   93F
1360 DATA E8, AB,  6, 8B, DE, 8B, D7, BD,  0,  0, AD,  D, 20, 2B, 3D, 6E,   6C6
1370 DATA 6F, 75, 14, AD,  C, 20, 3C, 74, 75,  D, 80, FC, 20, 77,  8, 45,   563
1380 DATA 32, DB, E8, B9,  6, 8B, DE, 8B, F3, AC, 3C, 3D, 74, 18, 3C,  9,   761
1390 DATA 74,  6, 3C, 20, 72,  D, 75, F1, AC, 3C,  9, 74, FB, 3C, 20, 74,   5EB
1400 DATA F7, 73,  3, EB, 7B, 98, 81, 7C, FF, 3D, 3D, 75, 7A, 46, 56, 8B,   7EF
1410 DATA F3, 57, 47, 8B, D7, 2B, 16, 4A,  2, B4,  1, E8, 20,  4,  B, DB,   62F
1420 DATA 8B, DA, 5B, 88,  F, B1,  1, 74, 14, BB,  8, 10, E8, 41,  5, 8B,   645
1430 DATA  8,  0, B9, 21,  0, E8, 5A,  4, 8B, D3, B9,  2,  0, 5E, 52, 51,   542
1440 DATA 57, 47, 8B, D7, 2B, 16, 4A,  2, B4,  1, E8, F9,  3,  B, DB, 5B,   667
1450 DATA 8B,  F, B9, 10,  0, 74, 14, BB,  8, 10, E8, 13,  5, BB,  6,  0,   474
1460 DATA B9, 21,  0, E8, 2C,  4, 8B, D3, B9, 20,  0, BB, C3, 13, E8, FF,   7A1
1470 DATA  4, 5B, 88, E3,  F,  A, CB, 8B, DA, 5A, E8, 15,  4, EB, 67, 90,   748
1480 DATA BA, 3B,  3, F9, E9, 8C,  0, 0B, F3, BF, 2B,  2, E8, 08, FD, 83,   8BD
1490 DATA F9,  A, 75,  A, F3, A6, 75,  6, BB, FA, 13, 53, EB, 12, 8B, F3,   82C
1500 DATA BF, 35,  2, 83, F9,  5, 75, D8, F3, A6, 75, D4, BB, DD, 13, 53,   BA4
1510 DATA 32, DB, E8, B9,  5, 8B, FA, 2B, 16, 4A,  2, B4,  1, E8, 86,  3,   6EB
1520 DATA 32, C0, AA, B1, 21,  B, DB, 74, 13, BB,  8, 10, E8, A1,  4, BB,   6EE
1530 DATA  6,  0, B9, 21,  0, E8, BA,  3, 8B, D3, B1, 22, 5B, E8, 90,  4,   60D
1540 DATA BB,  8,  0, E8, AC,  3, B9,  0,  2,  B, ED, 74,  3, B9,  8,  3,   54B
1550 DATA 8B, 9F,  3, 50, FF, 36, 46,  2, 32, DB, E8, 71,  5, E8, A0, FC,   846
1560 DATA 59, 5B, 72,  F,  6, A1, 46,  2, 8E,  6, 48,  2, 2B, C1, 26, 89,   49D
1570 DATA  7,  7, F8, C3, 80, 3E, 3D,  2,  0, 74,  7, BA, AB,  3, F9, E9,   6BB
1580 DATA D4,  8,  6,  6, 3E,  2,  0, FE,  6, 3D,  2, 32, DB, E8, 3E,  5,   55B
1590 DATA 72,  D, 8B, EE, 8B, D7, 2B, 16, 4A,  2, AC, 3C,  D, 75,  3, E9,   63D
1600 DATA BE,  8, 3C, 28, 75, F4, B4,  2, E8, FB,  2, 32, C0, AA, FF, 36,   7F7
1610 DATA 46,  2, B1, 11, 8B,  6, 10, E6, 16,  4, BB,  A,  8, B9, 21,  0,   476
1620 DATA E8, 2F,  3, 8B, D3, B1, 12, BB, 23, 14, E8,  3,  4, 0B, DF, 2B,   6B1
1630 DATA 1E, 4A,  2, C7,  5,  8,  8, 47, 47, E8, 16,  3, B9,  0,  2, E8,   468
1640 DATA 10,  3, 58, FF, 36, 46,  2, 32, DB, E8, E2,  4, 72, 6F, B3,  1,   650
1650 DATA E8, DB,  4, 72, 68, 32, DB, E8, D4,  4, 72, 61, 56, 57, 8B, FE,   877
1660 DATA B3,  2, E8, C9,  4, 8B, D6, 8B, F5, B9,  3,  0, F3, A6, 75,  6,   81B
1670 DATA 4F, 4F, 8B, 7F, 2B, AB, 3B, FA, 72, ED, 5F, 5E, E8, E1, FB, 5A,   98F
1680 DATA 5B, 58, 72, 33, 2B,  6, 46,  2, 2D,  3,  0, B9,  0,  4, E8, C1,   467
1690 DATA  2, A1, 46,  2, 2B, C2,  6, 8E,  6, 48,  2, 26, 89,  7,  7, 88,   3F9
1700 DATA 3E, 3E,  2,  0, 74, 10, 8B, 16, 3F,  2, 8B, 82, 13, E8, 88,  3,   49F
1710 DATA B9,  1,  0, E8, 9C,  2, F8, C6,  6, 3D,  2,  0, C3, 83, C4,  6,   653
1720 DATA BA, 3B,  3, F9, EB, F1, C6,  6, 3E,  2,  1, 8B, EF, 32, DB, E8,   846
1730 DATA 5C,  4, 56, 33, C8, AB, 32, E4, E8, 2B,  2, 32, C0, AA, 5E, BA,   733
1740 DATA 5F,  3,  B, C9, 74, 60, 80, 3E, 3D,  2,  0, 75,  4,  8, DB, 74,   4DA
1750 DATA 3A, 8B,  0, 10, E8, 39,  3, 0B, D5, 2B, 16, 4A,  2, 89, 16, 3F,   4F4
1760 DATA  2, 83, C2,  2, 8B,  6,  0, B9, 21,  0, E8, 45,  2, 8B, D3, B9,   62A
1770 DATA 32,  0, 8B, 15, 13, E8, 18,  3, 33, DB, 80, 3E, 3D,  2,  0, 74,   497
1780 DATA  4, 8B, 1E, 3F,  2, E8, 2A,  2, EB, 15, 90, 8B, FD, E8, 36,  0,   638
1790 DATA 8B, C3,  5,  2,  0, 2B,  6, 4A,  2, B9,  0,  1, E8, 13,  2, B3,   43C
1800 DATA  2, E8, EA,  3, F0, C3, F9, EB, FC, 46, E0, 19,  0, 83, 7F,  2,   8BD
1810 DATA FF, 75,  D, A1, 46,  2, 89, 47,  2, B3,  2, E8, D0,  3, F0, C3,   767
1820 DATA BA, 5F,  3, F9, EB, F9, E8, 6E, FB, 83, F9,  0, 76,  3, B9,  8,   908
1830 DATA  8, 0B, EF, BF, 4E,  2, 8B, DF, 83, 3D, FF, 74,  B, 51,  3, 1F,   6A4
1840 DATA E8, C4,  8, 59, 8B, FD, 73, 14, 8B, FD, B8, FF, FF, AB, AB, BA,   A3A
1850 DATA C1, AA, F3, A4, 8B, C5, 2B, C3, 89,  7, 8B, DD, F8, C3, 8B, D7,   A55
1860 DATA 2B, 16, 4A,  2, B4,  1, E8, 5D,  1, 32, C0, AA, 47, 57, 32, E4,   5D8
1870 DATA E8, 53,  1, B6,  D,  0, AB, 5D, 88, 4E, FF, 2B, 2E, 4A,  2, B9,   63C
1880 DATA 11,  0,  B, DB, 74, 18, 52, 8B, D5, BB,  0, 10, E8, 61,  2, 8B,   666
1890 DATA  6,  8, B9, 21,  0, E8, 7A,  1, B9, 21,  0, 8B, E8, 5A, BB, 55,   5FD
1900 DATA 11, E8, 4C,  2, 8B, DO, E8, 69,  1, F8, C3, 47, 57, 56, BE, 3A,   7A8
1910 DATA  2, A5, A4, 5E, 32, E4, E8,  D,  1, 88,  D,  0, AD, 5D, 80, C1,   6C3
1920 DATA  3, 80, 4E, FF, 8B, D5, 2B, 16, 4A,  2, B9,  1,  0,  B, DB, 74,   5D9
1930 DATA 14, BB,  8, 10, E8, 19,  2, BB,  6,  0, B9, 21,  0, E8, 32,  1,   498
1940 DATA B9,  2,  0, 8B, D3, BB, 02, 12, E8,  5,  2, E0, 24,  1, F8, C3,   71F
1950 DATA 32, DB, E8, F9,  2, 8B, D7, 32, E4, E8, CA,  0, 32, C0, AA, 2B,   8E1
1960 DATA 16, 4A,  2, B9,  1,  0,  B, DB, 74, 14, BB,  8, 10, E8, 80,  1,   51E
1970 DATA BB,  6,  0, B9, 21,  0, E8, F9,  0, B9,  2,  0, 8B, D3, BB, 59,   6A9
1980 DATA 15, E8, CC,  1, E8, EB,  0, F8, C3, 32, DB, E8, C8,  2, 72, 2C,   8AD
1990 DATA  C, 20, 3C, 6F, 75, 24, 8B, 44,  1,  D, 20, 20, B3,  1,  3C, 6E,   3ED
2000 DATA 74,  A, 3D, 66, 66, 75, 15, FE, CB, 8A, 64,  3, 88, FC, 20, 77,   6DE
2010 DATA  B, 88, 1E, 55,  1, B3,  2, E8, 94,  2, EB, 36, 8B, D7, 32, E4,   6D3
2020 DATA E8, 63,  8, B8,  A,  D, AB, 32, C0, AA, B9,  1,  8, 2B, 16, 4A,   5A6
2030 DATA  2,  B, DB, 74, 14, BB,  8, 10, E8, 75,  1, 8B,  6,  0, B9, 21,   534
2040 DATA  8, E8, 8E,  0, 8B, D3, B9,  2,  0, BB, 24,  F, E8, 61,  1, EB,   6AF
2050 DATA 80,  8, F8, C3, BB, 74,  F, E8, 56,  1, B9,  0,  8, E8, 72,  0,   6C9
2060 DATA B3,  2, E0, 49,  2, F8, C3, BB, A0,  F, E0, 43,  1, B9,  8,  0,   6FA
2070 DATA E8, 5F,  0, B3,  2, E0, 36,  2, F8, C3, 4E, AC, 3C, 1A, 74, 69,   69F
2080 DATA 3C,  D, 75, F7, F8, C3, 52, 8B, D7, 33, DB, 88, 33, C9, AC, 3C,   81F
2090 DATA 74,  4, 3C,  D, 76, 3A, 80, FC,  2, 75,  4, 3C, 29, 74, 31, 80,   4F2
2100 DATA FC,  1, 75,  8, 3C, 20, 76, 28, 3C, 3D, 74, 24, 41, 3C, 25, 75,   49C
2110 DATA 1C, FE, C7,  A, DB, B3,  0, 75, 14, 80, 3C, 7F, 75,  5,  A, AC,   70D
2120 DATA 46, E8,  A, 80, 3C, 39, 76,  5, E8, 0C, F9, FE, C3, AA, EB, BD,   92B
2130 DATA 5A, C3, 55, 56, 57,  6, C4, 3E, 46,  2, 0B, E9, 00, E1,  7,  B,   6D3
2140 DATA F9,  1, 75,  D, BE, B6,  E, 89, 54,  2, B9,  4,  0, F3, A4, EB,   71C
2150 DATA 22, 88, F9,  2, 75,  D, BE, BA,  E, 89, 54,  2, B9,  4,  0, F3,   634
2160 DATA A4, EB, 18, 88, F9,  3, 75,  B, BE, BE,  E, 89, 54,  1, B9,  3,   6BF
2170 DATA  8, F3, A4, 8B, CD, 80, E1, F8, 80, F9, 10, 75,  D, BE, C1,  E,   8DB
2180 DATA 89, 5C,  2, B9,  4,  8, F3, A4, EB, 22, 88, F9, 28, 75,  D, BE,   721
2190 DATA C5,  E, 89, 5C,  2, B9,  4,  0, F3, A4, EB, 10, 88, F9, 30, 75,   727
2200 DATA  B, BE, C9,  E, 89, 5C,  1, B9,  3,  0, F3, A4, 8B, CD, 80, E5,   796
2210 DATA  F, 75,  D, BE, 9E,  E, B9,  5,  0, 89, 44,  1, F3, A4, EB, 46,   64F
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BAT2EXEC.BAS: As an alternative to assembling BAT2EXEC.ASM, the BAT2EXEC.COM program can also be created by running this listing in BASIC.

BAT2EXEC.BAS 2 of 2

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2010 DATA 80, FD,  1, 75,  D, BE, A3,  E, B9,  6,  0, 89, 44,  2, F3, A4,  694
2020 DATA EB, 34, 80, FD,  2, 75,  D, BE, A9,  E, B9,  5,  0, 8D, 45,  3,  628
2030 DATA F3, A4, EB, 22, 80, FD,  3, 75,  D, BE, AE,  E, B9,  5,  0, 8D,  768
2040 DATA 45,  3, F3, A4, EB, 18, 80, FD,  4, 75,  8, BE, B3,  E, 89, 44,  727
2050 DATA  1, 89,  3,  0, F3, A4, 2E, 89, 3E, 46,  2,  7, 5F, 5E, 5D, C3,  575
2060 DATA 51, 52, 8B, 47, FC,  B, C0, 75, 34, 8B, CB, 87, 1E, 42,  2, 89,  6AD
2070 DATA  F, 8B, 47, FE,  3, 47, FC, 2B, 47,  2, 8B, D9, 8B, 4F,  2,  3,  5DC
2080 DATA C1, 89, 47, FC, E3, 17, D1, E9, 83, C3,  4, 50, 51, 53, 8B, 1..  829
2090 DATA E8, CD, FF, 5B, 89,  7, 83, C3,  2, 59, E2, F0, 58, 5A, 59, C3,  8E0
2100 DATA 1E,  E, 1F, B4,  9, CD, 21, 1F, C3, 52, E8, F3, FF, BA, C6,  3,  707
2110 DATA E8, ED, FF, 5A, C3, 53, B9,  5,  0, 33, D2, BB,  A,  0, F7, F3,  8B6
2120 DATA 80, C2, 30, 52, E2, F3, B9,  5,  0, B3, 30, 5A,  A, DA, 80, FB,  7F3
2130 DATA 30, 74,  4, B4,  2, CD, 21, E2, F2, 5B, C3, 56, 8B, D6, BF, 8D,  841
2140 DATA  2, B9,  0,  0, AC, 3C, 20, 74,  7, 3C, 2E, 74,  3, AA, E2, F4,  5A7
2150 DATA BE, 8B,  2, A4, A5, A5, C7,  6, 82,  2,  8,  0, 8B, F2, B3,  1,  6B8
2160 DATA E8, 4F,  0, 4E, C6,  4,  0, B8,  0, 3D, CD, 21, 72, 3E, 8B, D8,  645
2170 DATA B4, 3F, 8B, 16, 7E,  2, 8B,  E, 80,  2, CD, 21, 3B, C1, 76, 16,  5A5
2180 DATA FD, 57,  6,  E,  7, 8B, F8, B0,  D, F2, AE, 8B, C7,  7, 5F, A3,  7AA
2190 DATA 82,  2, 89, 1E, 84,  2, C7,  4,  D, 1A, 8B, C8, 8B, F2, B4, 3E,  665
2200 DATA CD, 21, 2E, C7,  6, 86,  2,  0,  0, F8, 5E, C3, F9, BA, E2,  2,  721
2210 DATA EB, F8, E8,  9,  8, 73,  6, 2E, FF,  6, 86,  2, F9, C3, AC, 3C,  7AC
2220 DATA  D, 74,  4, 3C, 1A, 75,  3, F9, EB, 13, 80, FB,  1, 74,  8, 77,  5B9
2230 DATA ED, 3C, 20, 76, E9, EB,  4, 3C, 20, 77, E3, 4E, F8, C3, B8, 34,  842
2240 DATA 12, FF, D8, 8B, 86, 34, 12, FF, E8, 73,  3, E9, 1B, F5, 72,  3,  7FB
2250 DATA E9, 16, F5, E9, 13, F5, 8D, B6, 34, 12, 8B, B6, 34, 12, BE, 34,  7E7
2260 DATA 12, 8D, BE, 34, 12, 8B, BE, 34, 12, BF, 34, 12,  0,  0,  0,  0,  437
2270 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0
2280 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  1, 21,  0,  0,  0,  22
2290 DATA  0,  0, BD, 1F,  1, 8B, 6E,  0, 8B, A6,  2,  0, 8B, 9E,  4,  0,  436
2300 DATA B4, 4A, CD, 21, A1, 2C,  0, 89, B6, 18,  0, 8B, 9E,  0,  0, FF,  688
2310 DATA E3,  0,  0,  0,  5,  0,  0,  0,  0,  0,  0, 88,  0, 4C, CD, 21,  2DA
2320 DATA  0,  0,  E,  0,  0,  0,  0,  0, 8A, 14, 46,  A, D2, 74,  6, B4,  2FC
2330 DATA  2, CD, 21, EB, F3, C3,  0,  0, 32,  0,  0,  0,  0,  0, E8, 14,  4BF
2340 DATA  0, 45, 43, 48, 4F, 20, 69, 73, 20, 24, 6F, 6E,  A,  D, 24, 6F,  3E6
2350 DATA 66, 66,  A,  D, 24, 5A, 50, B4,  9, CD, 21, 81, C2,  9,  0, 58,  500
2360 DATA  A, C0, 74,  7, 81, C2,  5,  0, 83, C2,  5, B4,  9, CD, 21, C3,  645
2370 DATA  0,  0, 2C,  0,  0,  0,  0,  0, E8, 1F,  0, 53, 74, 72, 69, 6B,  348
2380 DATA 65, 20, 61, 6E, 79, 20, 6B, 65, 79, 20, 77, 68, 65, 6E, 20, 72,  59A
2390 DATA 65, 61, 64, 79, 2E, 2E, 2E,  D,  A, 24, 5A, B4,  9, CD, 21, B4,  521
2400 DATA  7, CD, 21, C3,  0,  0,  5,  0,  0,  0,  0,  0, FE, 86, 1D,  0,  35E
2410 DATA C3,  0,  0, 19,  0,  0,  0,  0,  0, AC, 3C,  9, 74,  C, 3C, 20,  2A9
2420 DATA 72,  E, 74,  6,  A, D2, 75, F1, EB,  4,  A, D2, 74, EB, F8, C3,  821
2430 DATA F9, C3,  0,  0, 22,  0,  0,  0,  2,  0, B5,  F, 53, E8,  0,  0,  3DF
2440 DATA 5B, 32, D2, FF, 57, FA, 72, 11, FE, CE, 7E,  9, FE, C2, FF, 57,  99B
2450 DATA FA, 72,  4, EB, EC, 4E, F0, 5B, C3, F9, EB, FB,  0,  0, 61,  0,  8EB
2460 DATA  0,  0,  4,  0, 69, 10, D1, 19, 53, E8,  0,  0, 5B, 57, 56, B4,  455
2470 DATA FF, AC,  A, C0, 74,  9, 3C, 25, 74, 13, AA, FE, CC, 75, F2, 32,  7E7
2480 DATA C0, AA, 5E, 5F, B3, FF, 2A, DC, 80, 5D, FF, 5B, C3, AC, 40, 3C,  912
2490 DATA 25, 74, E7, 3C, 7F, 75, 12, 56, 8B, B6,  C,  0, AC, 3C,  0, 74,  5C1
2500 DATA  5, AA, FE, CC, 75, F6, 5E, EB,  F, 8A, F8, 80, EB, 30, 72,  E,  8D4
2510 DATA 80, FE,  9, 77,  9, FF, 57, F0,  A, E4, 75, B5, EB, C1, 4E, 41,  8AB
2520 DATA FF, 57, FA, EB, F3,  0,  0, 60,  0,  0,  0,  2,  0, D6,  F, 53,  5C8
2530 DATA E8,  6,  0, 44, 4F, 53, 32, 50,  0, 5B, 51, 56, 1E, BE, 80,  0,  4BC
2540 DATA 33, C9, 8A,  C, 46, 3E,  2, B6, 1D,  0,  A, F6, 75, 2B, 50, B4,  58F
2550 DATA 30, CD, 21, 3C,  2, 50, 77,  4, 8D, 37, EB, 22,  6, 57, 8E,  6,  4F1
2560 DATA 2C,  0, 32, C0, 33, FF, B9,  0, 60, F2, AE, AE, 75, FB, AF, 8B,  881
2570 DATA F7, 5F,  7, 8E, 1E, 2C,  0, EB,  5, FF, 57, FA, 72,  A, AC, 3C,  6D9
2580 DATA 20, 76,  5, AA, FE, CC, 75, F6, 1F, 5E, 59, 5B, C3,  0,  0, 2E,  69C
2590 DATA  0,  0,  0,  2,  0,  7, 11, 53, E6,  0,  0, 5B, 1E, B9, FF,  0,  386
2600 DATA 57, 8B, FE, 8B, D1, B0, 25, F2, AE, 2B, D1, 4A, 8B, CF, 5F, 51,  901
2610 DATA FF, 57, FA, 72,  A, AC,  A, C0, 74,  5, AA, FE, CC, 75, F6, 5E,  8F8
2620 DATA 1F, 5B, C3,  0,  0, 46,  0,  0,  0,  0,  0, 53, 51, 57,  6, 8E,  312
2630 DATA 86, 10,  0, 33, FF, 8B, DE, 8B, F3, 8B, CA, F3, A6, 74, 14, 32,  85F
2640 DATA C0, B9, FF, FF, F2, AE, 26, 80, 3D,  0, 75, EB, 8B, F7,  6, 1F,  901
2650 DATA F9, EB, 19, 8B, F7,  6, 1F, AC, 3C, 3D, 75, FB, 80, 3C,  0, 74,  769
2660 DATA FB, AC,  A, C0, 72,  4, 3C, 20, 72, F7, 4E, F8,  7, 5F, 59, 5B,  6FC
2670 DATA C3,  0,  0, DA,  0,  0,  0,  A,  0, 82, 12, 24,  F, 37, 12, C1,  378
2680 DATA 12, DD, 13, 53, E8, 30,  0,  0, 50, 41, 54, 48, 3D, 43, 4F, 4D,  4B6
2690 DATA 45, 58, 45, 42, 41, 54,  0,  0,  0,  0, 42, 61, 64, 20, 63, 6F,  3B2
2700 DATA 6D, 6D, 61, 6E, 64, 20, 6F, 72, 20, 66, 69, 6C, 65, 6E, 61, 6D,  68A
2710 DATA 65,  D,  A,  0, 2F, 43, 20, 5B, 89, 77,  F, 89, 7F, 11, 8B, 96,  4B2
2720 DATA  8,  0, 83, C2,  4, 8B, FA, 33, C9,  A,  F, 74, 10, 8B, 77,  F,  580
2730 DATA FF, 57, F6, 73,  8, 8D, 77, 13, FF, 57, F4, EB, 74, B9,  0,  0,  848
2740 DATA AC, 3C, 20, 76,  7, 3C, 2E, 74,  3, AA, E2, F4, B0, 2E, AA, 8D,  6FB
2750 DATA 77,  6, B9,  3,  0, A5, A4, 32, C0, AA, 52, 56, 51, 8B, F2, FF,  793
2760 DATA 57, FA, 59, 5E, 5A, 73,  9, 83, EF,  4, E2, E9, FE,  7, EB, B5,  8C4
2770 DATA 83, B9,  1, 75, 33, 8D, 77, 2D, 83, EA,  4, 8B, FA, A5, A4, 32,  7C7
2780 DATA C0, B9, FC,  0, F2, AE, C6, 45, FF, 20, 8B, 77, 11, 38, 4C, FF,  8D5
2790 DATA 77,  3, BA, 4C, FF, F3, A4, C6,  5,  D, 8B, F2, 8B, C7, 2B, C2,  87A
2800 DATA 8E, 44, FF, FF, 57, F2, FB,  9, 8B, 7F, 11, 4F, 8B, F2, FF, 57,  944
2810 DATA F0, 8B, C3,  0,  0, 43,  0,  0,  0,  2,  0,  7, 11, 53, E8,  4,  3B2
2820 DATA  0, 50, 41, 54, 48, 5B, 5D, 56, BA,  4,  0, 8B, F3, FF, 57, FA,  6BC
2830 DATA 49, E3,  B, AC,  A, C0, 74, 03, 3C, 3B, 75, F7, EB, F2, AC, 3C,  7EC
2840 DATA 3B, 74,  7,  A, C0, 74,  1, AA, EB, F4,  E, 1F, 26, 80, 7D, FF,  6CF
2850 DATA 5C, 74,  3, B0, 5C, AA, FB, 5E, 5A, 5B, C3, F9, EB, F9,  0,  0,  034
2860 DATA 17,  0,  0,  0,  4,  0, C1, 12, A1, 12, 53, E8,  0,  0, 5B, 8B,  3C2
2870 DATA FE, 4F, 1E, FF, 57, FA, 2E, FF, 57, F0, 1F, 5B, C3,  0,  0, 10,  78C
2880 DATA  0,  0,  0,  2,  0,  7, 11, 53, E8,  7,  0, 43, 4F, 4D, 53, 50,  2DE
2890 DATA 45, 43, 5B, BA,  7,  0, 8B, F3, FF, 57, FA, 5B, C3,  0,  0, 4C,  6DC
2900 DATA  0,  0,  0,  0,  0, 53, EB, 10,  0,  0, 44, 55, 4D, 4D, 59, 20,  2F7
2910 DATA 20, 20, 46, 43, 42,  0,  0,  0,  0, 5B, 1E,  6, 89, A6,  2,  0,  2BB
2920 DATA  E, 8F, 17, 52,  E, 52,  E, 57, 33, C0, 50, 8B, DC, B8,  0, 4B,  576
2930 DATA 8B, D6, CD, 21, BD, 1F,  1, 2E, 89, 6E,  0, 8C, CB, FA, 8E, D3,  885
2940 DATA 8B, A6,  2,  0, FB,  7, 1F, B4, 4D, CD, 21, 80, 86, 1C,  0, 5B,  5C0
2950 DATA C3,  0,  0, 65,  0,  0,  0,  4,  0, 24,  F, 93, 13, E8, 1B,  0,  380
2960 DATA 20, 20, 20, 20, 20, 20, 20, 20, 20, 4C, 61, 62, 65, 6C, 20, 6E,  38E
2970 DATA 6F, 74, 20, 66, 6F, 75, 6E, 64,  D,  A,  0, 5B, 57, 8B, FB, 33,  5A1
2980 DATA D2, B9,  8,  0, AC, 3C, 20, 76,  E, 3C, 61, 72,  6, 24, DF, 3C,  573
2990 DATA 5A, 77,  4, AA, 42, E2, ED, 8B, CA, 8B, F3, 8B, BE, 16,  0,  3,  7C5
3000 DATA FD, 53, FF, 57, FB, 5A, 5E, 72,  F, 8B, 47,  2,  8, F6, 74,  3,  726
3010 DATA 99,  2, C3, 58, FF, 77,  2, C3, 8B, DA, FF, 57, F9, C3,  0,  0,  858
3020 DATA  9,  0,  0,  0,  0,  0, 33, C0,  B,  4, 74,  2, 5B, 50, C3,  0,  2EF
3030 DATA 83, C7,  4, 8B, F2, 8B, C8, 3B,  D, 75,  5, 47, F3, A6, 74,  C,  73D
3040 DATA 83, 3F, FF, 74,  4,  3, 1F, EB, E5, F9, EB,  1, F0, 5E, C3,  0,  829
3050 DATA  0, 12,  0,  0,  0,  0,  0, 33, C9, 8A, 4C, FF, 3A, 4D, FF, 75,  4DE
3060 DATA  6, F3, A6, 75,  2, F8, C3, F9, C3,  0,  0, 15,  0,  0,  0,  0,  5A2
3070 DATA  0, 8B, D7, B4, 1A, CD, 21, 8B, D6, 33, C9, B4, 4E, CD, 21, 72,  7DD
3080 DATA  4, 83, C7, 1E, F8, C3,  0,  0, 21,  0,  0,  0,  0,  0, 33, C0,  43B
3090 DATA 8B, D8, 8A, 1C, 80, EB, 30, 72, 11, 80, FB,  9, 77,  C, BA,  A,  6F2
3100 DATA  0, F7, E2, 72,  5,  3, C3, 46, EB, EB, 38, 86, 1C,  0, C3,  0,  6CC
3110 DATA  0, 92,  0,  0,  0,  2,  0, D6,  F, 53, E8, 2B,  0,  0,  0,  0,  2DF
3120 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0
3130 DATA  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0,  0
3140 DATA  0,  0,  0,  0,  0,  0,  0,  0, 5B, 8D, 17, B4, 1A, CD, 21, 80,  33B
3150 DATA 7D,  1,  0, 74,  B, B4, 4F, CD, 21, 72,  5, 8D, 57, 1E, EB, 3B,  58D
3160 DATA C6, 45,  1,  0, FE,  5, 8A, 35, FF, 57, FA, 72, 35, 88, D6, 32,  750
3170 DATA E4, AC, 3C, 20, 76,  E, 3C, 3E, 75,  2, FE, C4, 3C, 2A, 75, F1,  6F8
3180 DATA FE, C4, EB, ED, C6, 44, FF,  0,  A, E4, 74,  F, C6, 45,  1,  1,  821
3190 DATA 33, C9, B4, 4E, CD, 21, 72, C8, 8D, 57, 1E, 89, 96,  C,  0, F8,  74B
3200 DATA 5B, C3, C7,  5,  0,  0, F9, EB, F7,  0,  0, 94,  0,  0,  0,  0,  559
3210 DATA  0, 53, E8,  9,  0, 43, 4F, 4D, 4D, 41, 4E, 44,  0,  0, 5B,  6,  3A4
3220 DATA A1, 2C,  0, 39, 86, 18,  0, 75, 79, B4, 30, CD, 21, 86, C4, 89,  637
3230 DATA 47,  7, B4, 52, CD, 21, 26, 8B, 47, FE, B9, 14,  0, 8E, C0, 26,  679
3240 DATA 80, 3E,  0,  0, 4D, 75, 5B, 40, 26, 3B,  6,  1,  0, 74,  9, 26,  326
3250 DATA  3,  6,  3,  0, E2, E7, EB, 4A, 81, 7F,  7,  0,  A, 73, 15, 81,  524
3260 DATA 7F,  7,  0,  4, 72,  E, 1E, 8D, 37, BF,  8,  0, B9,  7,  0, F3,  666
3270 DATA A6, 1F, 75, DB, 8E, C0, 26, 8B, 1E, 2C,  0, 8B, C3, 4B, 8E, C3,  748
3280 DATA 26, 80, 3E,  0,  0, 4D, 74, 16, 8B, D0, 40, 8E, C0, 26,  3,  6,  4D8
3290 DATA  3,  0, 40, 26, 39, 16,  1,  0, 74,  4, 8E, C0, E2, EF, 89, 86,  55F
3300 DATA 10,  0,  7, 5B, C3,  0,  0, B3,  0,  0,  0,  6,  0, BD, 14, 24,  2EB
3310 DATA  F,  7, 11, 53, E8, 1B,  0, 4F, 75, 74, 20, 6F, 66, 20, 65, 6E,  49D
3320 DATA 76, 69, 72, 6F, 6E, 6D, 65, 6E, 74, 20, 73, 70, 61, 63, 65,  D,  61B
3330 DATA  A,  0, 5B, FF, 57, F6, 55,  6, B9, FF,  0, 33, D2, 56, 8B, FE,  7A9
3340 DATA AC, 3C, 3D, 74,  E, 3C, 61, 72,  6, 24, DF, 3C, 5A, 77,  4, AA,  57A
3350 DATA 42, E2, ED, 5E, 8B, C6, 47, 2E, 80, 30, 20, 73,  2, 33, C0, 50,  6CA
3360 DATA FF, 57, FA, 5A, 1E,  7, 8B, FE, 72, 21, 32, C0, FD, B9,  0,  1,  794
3370 DATA F2, AE, 47, 47, 57, FC, B9,  0,  1, F2, AE, 8B, F7, 5F, 32, E4,  8D2
3380 DATA AC, AA,  A, E0, 74,  4, 8A, E0, EB, F6, 4F,  E, 1F, 8B, F2,  B,  807
3390 DATA F6, 74, 29,  6, 8C, C0, 48, 8E, C0, 26, 8B, 2E,  3,  0, B1,  4,  612
3400 DATA D3, E5, 4D, 4D,  7, AC, AA,  A, C0, 74,  E, 3B, FD, 72, F6,  E,  7A9
3410 DATA 1F, BD, 37, FF, 57, F8, 32, C0, AA, 32, C0, AA,  7, 5D, 5B, C3,  7EB
3420 DATA  0,  0, 41,  0,  0,  0,  0,  0, C7, 86,  E,  0, FF, FF, 8B, D6,  4FB
3430 DATA 33, C9, 8B,  2, 3C,  B, FF, 74,  2, FE, C4, CD, 21, 72, 29, 8B,  748
3440 DATA DB,  B, FF, 74,  B, B0,  2, 42, 33, D2, 8B, CA, CD, 21, 72, 18,  72F
3450 DATA 89, 9E, 10,  0, 53, B4, 45, 8B,  1,  0, CD, 21, 89, 86,  E,  0,  54A
3460 DATA B9,  1,  0, 5B, B4, 46, CD, 21, C3,  0,  0, 1B,  0,  0,  0,  0,  3D8
3470 DATA  0, 83, BE,  E,  0, FF, 74, 13, B4, 46, 8B, 9E,  E,  0, B9,  1,  5C0
3480 DATA  0, CD, 21, B4, 3E, 8B, 9E, 10,  0,  0, CD, 21, C3,  0,  0, 26,  4F0
3490 DATA  0,  0,  0,  0, C7, 86, 12,  0, FF, FF, 8B, D6, 8B,  0, 3D, CD,  680
3500 DATA 21, 72, 16, 89, 86, 14,  0, 50, B4, 45, 33, DB, CD, 21, 89, 86,  620
3510 DATA 12,  0, 33, C9, 5B, B4, 46, CD, 21, C3,  0,  0, 1A,  0,  0,  0,  42E
3520 DATA  0,  0, 83, BE, 12,  0, FF, 74, 12, B4, 46, 8B, C9, 33, 9E, 12,  609
3530 DATA  0, CD, 21, B4, 3E, 8B, 9E, 14,  0, CD, 21, C3,  0,  0,  7,  0,  4D5
3540 DATA  0,  0,  0,  0, 8B, D6, B4, 41, CD, 21, C3, 90,  0,  0,  0,  0,  497
3550 DATA 532731
```

ters are saved. Since under DOS 2.*x* even the stack register can be changed, the stack pointer is saved as well. After the program returns, the return code is retrieved using Get Return Code of Child Process (function 4Dh). This return code is saved in a byte in the global data area so that it can be accessed by the IF statement ERRORLEVEL routine.

The program terminates when it has completed all calls in the main routine. A call is made to the DOS function Terminate Process with return code. Files compiled by BAT2EXEC always return an error code of zero.

OPERATIONAL DIFFERENCES

Programs created by BAT2EXEC behave slightly differently from their original batch files. The .COM file doesn't echo each line to the screen as does the batch file. Running other batch files doesn't cause the .COM program to end. Also, pressing Ctrl-Break does not present the message, "Terminate Batch file (y/n)." If Ctrl-Break is pressed and BREAK has been set on, the program simply ends.

The resulting .COM file is somewhat larger than the batch file. Compiling a batch file containing a single REM statement results in a .COM file size of 68 bytes, illustrating the overhead of the setup and terminate routines. Program size increases quickly as routines are added, then slower, as the loaded routines are reused instead of new ones being added.

Certainly, BAT2EXEC is not suitable for use on every batch file. Two- and three-line batch files are best left in their easy-to-alter and simple-to-understand ASCII format. However, for those batch files that have grown into long complex programs, BAT2EXEC is the answer. ■

Douglas Boling is a contributing editor of PC Magazine.

Hard Disks Die.

Hard disk manufacturers want us to believe that hard disk technology is absolutely reliable ... but experience teaches otherwise. We depend upon data storage to be flawless, but hard disk technology isn't. Surface defects, head alignment drift, and low-level format aging cause hard disks to fail.

A hard disk drive's low-level format fades with use. The drive's read/write heads lose their delicate alignment and move away from the original low-level format information. These new data track locations intersect unseen surface defects that were once harmlessly located between tracks. DOS's chilling "Abort, Retry, or Fail ?" message inevitably results. Precious data is soon lost.

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by
Charles Petzold

Environments

Taking Advantage Of the 386: The 32-bit Version of OS/2

■ You don't have to wait for the final version of OS/2 2.0 to write Presentation Manager programs. Here are some hints to get you started.

Now, everyone who likes porting, raise your hand. Higher, please—hmm, I don't see any hands.

Porting is no fun. But it's necessary, from time to time, to keep applications in pace with advances in hardware and operating systems. Just in the world of PCs, recent years have seen programmers porting applications from DOS character mode to OS/2 character mode, from DOS character mode to *Windows* and the OS/2 Presentation Manager, and from *Windows* to PM. Of course, moving a program from character mode to a graphical environment isn't exactly a *port* in the traditional sense of the word. It's more like ripping the program apart and putting it back together with a new user interface.

Porting has become desirable—if not exactly necessary—even between successive OS/2 versions. No sooner have OS/2 programmers recovered from adapting their programs to take advantage of the long filenames and extended attributes in the High Performance File System (HPFS) of OS/2 1.2 than another significant version of the operating system peeks over the horizon.

It's OS/2 2.0, coming at you.

Early versions of the OS/2 2.0 Software Development Kit (SDK) supposedly began shipping late in December, but they didn't reach most purchasers until January or February. Although the cost of the OS/2 2.0 SDK is lower than that of the SDK Microsoft released for OS/2 1.0 and 1.1 ($2,600 rather than $3,000), it's still outrageously high. After OS/2 2.0 is released on the retail level, a toolkit will probably be available for much less, and this is when most OS/2 programmers will get their first taste of the new system. The OS/2 2.0 SDK is mainly for people willing to put up with buggy and incomplete operating system code to get a head start on developing 32-bit OS/2 programs.

At the time I'm writing this column—early April—the official word is that the retail version of OS/2 2.0 will ship by the end of 1990. However, most everyone who's seen the beta version of OS/2 2.0 is skeptical, and even some high-ranking Microsoft executives have let slip that delivery may be delayed until 1991. We shall see.

GOING FLAT

From the programmer's perspective, the biggest change in OS/2 2.0 over previous versions can be summed up in three words: no more segments.

OS/2 2.0 will be the first version of the operating system designed to take full advantage of the 80386 microprocessor. We'll have 32-bit registers and addressing, virtual memory based on 4K memory pages, and the ability to run multiple virtual DOS machines (MVDMs). But the most significant decision IBM and Microsoft had to make regarded segments. Would OS/2 2.0 continue to use segments and simply expand maximum segment size from 64K to 4 gigabytes, or would segments be eliminated in favor of a 32-bit *flat* or *linear* address space?

They decided to go flat. Segments have been eliminated in the 32-bit application programming model. The primary reason for this decision has to do with the future of OS/2. Both IBM and Microsoft seem interested in porting the operating system and its applications to processors beyond the 386 and 486, particularly RISC (reduced instruction set computing) machines. And this transition is much easier if the memory space is flat rather than segmented.

THE 32-BIT API

You're going to hear a lot during this year about certain function calls being changed and even eliminated in OS/2 2.0. But that's not the entire story, so don't get too worried.

It's true that some OS/2 function calls have certainly been changed and some of them eliminated in the 32-bit API (Application Programming Interface). However, OS/2 2.0 will continue to run 16-bit OS/2 programs that were written for earlier versions. Indeed, Microsoft has stated publicly that if an OS/2 1.2 application fails to run under OS/2 2.0, it will be considered a bug in the operating system.

What this means is simple: if you don't want to port an existing OS/2 program to the 32-bit API, you don't have to. That program will still run under OS/2 2.0. And, it's quite likely that a 32-bit OS/2 2.0 program will still be able to make calls to 16-bit functions that have no counterpart in the 32-bit API.

It's vital to understand what Microsoft and IBM are attempting with the 32-bit API of OS/2 2.0. They want an API that's not linked to the hardware of the IBM-compatible PC and the Intel 386 and 486 microprocessors. Historically, once an op-

erating system becomes accepted, it tends to stay around longer than anyone had ever anticipated. OS/2 is too important to seem moldy after a couple of years.

Here's an example. The Vio (video I/O), Kbd (keyboard), and Mou (mouse) functions that were used by OS/2 character-mode programs don't exist in the 32-bit API. (At least this is the case with the first beta release.) Why is this? To answer the question, take a look at these functions—they are tightly linked to PC hardware. The Vio functions, for instance, are tailored for a video adapter with alternating character and attribute bytes, and the Kbd functions report keyboard scan codes. These APIs cannot easily be adapted to hardware that's very different.

KERNEL CHANGES, PM CHANGES

There's no practical way that an operating system can progress from a 16-bit segmented model to a 32-bit flat model without some changes in the API. The most significant impact, of course, concerns the memory management functions, and this has produced some obvious changes. Functions such as DosAllocSeg have been replaced with functions such as DosAllocMem. However, there is another big change that you may not have considered: it was felt by the OS/2 developers at Microsoft that the existing semaphore APIs were flawed and too confusing. As a consequence, they've all been replaced with new functions.

The good news is that OS/2 2.0 has a minimal impact on the Presentation Manager API. There are some changes, to be sure, and a few enhancements, but none of them is very significant. Of course, this may not be true by the time OS/2 2.0 is finished. I have yet to see a version that implements True Type, Microsoft's vector font technology derived from Apple's Royal. It's not clear whether this will affect the font-selection APIs. (I would prefer that the APIs for font selection be simplified, but I haven't been able to convince anyone at Microsoft.)

In this column, I'll mostly discuss the changes to the Presentation Manager rather than to the kernel, which I'll leave to my colleague Ray Duncan in his Power Programming column. I'll keep you posted in this space on future developments as the beta releases become available.

HINTS FOR FUTURE PORTABILITY

If you're waiting for the OS/2 2.0 smoke to clear to begin your climb up the PM programming ladder, you're waiting unnecessarily. The Presentation Manager API has been very stable since OS/2 1.1. There don't appear to be any significant changes for OS/2 2.0. Furthermore, if you begin coding for PM under OS/2 1.1 and 1.2 now, you'll have a fairly easy time porting to the 32-bit API.

> If you develop applications for OS/2 1.2, you are able to accommodate long filenames and make use of extended attributes. These advantages put you in better shape for porting to OS/2 2.0.

Based on my experience with porting some OS/2 1.1 programs to OS/2 2.0, including those presented in my book *Programming the OS/2 Presentation Manager* (Microsoft Press, 1989), I have a few hints for you:

- Try to avoid the kernel memory-management functions such as DosAllocSeg. As I mentioned, these functions disappear in the 32-bit API. If possible, use normal C memory allocation functions such as malloc instead. Of course, you can't use malloc to allocate shared memory blocks for use with the Clipboard and other forms of interprocess communication, but malloc is fine for most other purposes.
- Avoid dependencies on the size of the int data type. This is a very common rule for writing portable C code, but it's worth repeating. In C compilers for the 286, the int is 16 bits; in C compilers for the 386, the int is 32 bits.
- Use the OS/2 header files and data types. The purpose of these header files is to hide implementation-specific details from your code. While they don't solve all porting problems, they do help.
- You'll be in better shape for portability if you develop for OS/2 1.2 rather than OS/2 1.1. First, you can make allowances for long filenames and take advantage of extended file attributes. Second, OS/2 1.2 introduced a new group of functions with the Prf (profile) prefix. Many of these functions (such as PrfQueryProfileData) are identical to their OS/2 1.1 Win counterparts (such as WinQueryProfileData). You can use either name in OS/2 1.2. However, I advise you to use the new name, because that's the one supported in the 32-bit API.
- Try to avoid dealing with segments. Avoid the near, far, huge, and _loadds keywords. These are irrelevant in a flat nonsegmented memory space. In order to avoid dealing with segments, you may want to follow the next rule.
- Use the large model. Do I hear you saying "Physician, heal thyself"? I'll admit it. Every single-threaded PM program I've published in my book and this column has used the small model. But that's a habit I picked up from my days of programming for *Microsoft Windows*. A large-model program will port more cleanly. For example, one of the small-model programs in my book required that I copy and find the length of zero-terminated strings addressed by far pointers. I had to write a couple of functions in order to do this, and these functions are not necessarily in the 32-bit model.
- Consider the huge memory model. I didn't say use it, I said consider it. If your program is carrying around giant chunks of data that must be broken into pieces of less than 64K because of segment limitations, you may be in better shape using the huge model, or at least having a couple of huge arrays or using halloc to allocate blocks of memory greater than 64K. (I realize this violates one of the other rules—because huge and halloc disappear in a 386 C compiler—but I'll let you make the decision based on your application.)
- Avoid using the Advanced VIO (AVIO) interface in your Presentation Manager programs. There's a good chance that this interface will not be part of the 32-bit API. Bite the bullet and use GPI functions for text.
- Last (but certainly not least), don't write Presentation Manager programs in assembly language. It may be an interesting exercise, but changing that program to take full advantage of the 386 instruction

set will not be fun. Moreover, when OS/2 is eventually ported to RISC processors, you'll have a very big job ahead of you. Life is too short to program in assembly language.

WINDOW PROCEDURES AND DLLs

Abandoning segments simplifies some aspects of OS/2 and Presentation Manager programming that have been irritating from the very beginning. One annoyance involves the special treatment of window procedures in PM programs. Window procedures are functions in your PM program that are called from the PM dynamic link libraries (DLLs). When the DLL calls the window procedure, the DS register contains the segment address of the DLL's data segment. The window procedure must contain some prologue code that loads the DS register with the segment address of the program's default data segment. It will also require some epilogue code to restore the DS register before returning to the DLL.

Under OS/2 1.1 and 1.2, there are three ways to do this, none of them entirely satisfactory:

- You can use the -Au compiler switch. This causes the compiler to generate special prologues and epilogues that set and restore the DS segment. These prologues and epilogues are added to all functions in the source code module. But this is overkill: not all functions in the program require this prologue and epilogue. Only window procedures need it.
- You can use the _loadds keyword when defining the window procedure. (This, by the way, happens automatically when you define the window procedure with EXPENTRY using the OS/2 1.2 header files.) This is a good solution, but the keyword causes the compiler to assume that DS is not equal to SS, and as a consequence the compiler might generate bogus warning messages.
- You can compile with the -Gw switch and list the window procedures in the EXPORTS section of the module-definition file. This method was used in *Microsoft Windows*, and it's the method that I have tended to use. But it has two problems you should be aware of: the function prologue and epilogue contain more than what's needed, and you have to remember to add each window procedure to the EXPORTS section of the .DEF file.

All this nonsense disappears under OS/2 2.0. Your program and all the dynamic link libraries your program uses are part of the same 32-bit address space. Window procedures require no special treatment.

When you compile a multithreaded program under the current versions of OS/2, you should use the -Aw switch to tell the compiler that DS is not equal to SS. This is because the thread's stack may not be part of the program's data segment. There are certain things you can do in C that implicitly assume that static data and the stack are in the same segment. Currently, you can't do these things in a function running in a second thread of execution. However, in Version 2.0 of the operating system, this problem also disappears, because all the program's static data and all the thread stacks are part of the same 32-bit address space.

Functions in dynamic link libraries written for the 16-bit versions of OS/2 need to contain a prologue that loads DS, and the libraries must be compiled with the -Aw switch, because libraries use the stack of the program calling them. Again, this problem disappears.

> With OS/2 2.0, window procedures require no special treatment, because your program and all the dynamic link libraries your program uses are part of the same 32-bit address space.

Window procedures and DLL entry points are currently defined with the Pascal calling sequence. This is a holdover from *Microsoft Windows*, in which it was discovered that switching to the Pascal calling sequence required one less distribution disk in the original release! In the 32-bit API, window procedures and DLL entry points use the C calling sequence.

The names APIENTRY (used for operating system function calls) and EXPENTRY (used for window procedures) are defined the same in the OS/2 2.0 header files:

```
#define APIENTRY _syscall
#define EXPENTRY _syscall
```

The _syscall keyword causes the compiler to convert the function name to uppercase and not to precede the name with an underscore when it appears as an external reference. It's no big deal.

Another simplification involves the stack for a secondary thread of execution. Under the earlier versions of OS/2, the program first had to allocate the stack space and later free it when the thread terminated. But the process of determining when the thread terminates can be tricky. Under the 32-bit version of OS/2, the system itself allocates the stack memory for the thread and automatically frees it when the thread terminates.

NEW WIN FUNCTIONS

OS/2 adds several new Win functions for manipulating structures and variables. Here's the good news: if you're a C programmer, you can ignore them! These functions are designed specifically for high-level languages such as COBOL and FORTRAN that don't support all the bit manipulation and casting available in C.

Do you remember the POPMENU program that I wrote for the November 28, 1989, Environments column? That program displayed a pop-up menu at the mouse pointer position whenever you clicked the right mouse button on the client window. OS/2 2.0 has a function called WinPopupMenu that is designed specifically for this purpose.

One function in OS/2 2.0 listed in the header file but not documented is WinSetDesktopBkgnd. This function lets a PM program specify a particular bitmap that the system uses as the background of the Presentation Manager session. Although there are some existing programs that will accomplish the task, this function certainly makes it a lot easier.

When working with menus, buttons, and list boxes, you find that it's often necessary to call WinSendMsg or WinSendDlgItemMsg to send the control a message. For example, you send a MM_SETITEMATTR message to the menu to put (or remove) a checkmark next

to an item on the menu. The PMWIN.H header file for OS/2 2.0 has a bunch of handy macros (with names like WinCheckMenuItem) to simplify these chores.

PALETTE MANIPULATION

Aside from the new font technology, the OS/2 2.0 Graphics Programming Interface has two major enhancements. The first is a new collection of functions used for manipulating the color palettes of video displays.

This will be most useful for video adapters such as the IBM 8514/A. The 8514/A is capable of rendering 262,144 colors, but only 256 of these colors can appear on the screen simultaneously. Currently in the Presentation Manager, these 256 colors are chosen by the 8514/A driver and there is no way for an application to change them.

Eight new palette functions in OS/2 2.0 now give PM applications the ability to change the palette. For example, if a PM program running on an 8514/A wants to display an image with 64 shades of gray in its window, it can define a palette using these colors.

Palette manipulation in a windowing environment can be tricky. Any change to the palette affects the entire screen and hence all the programs running in the PM session. If one program wants 64 shades of gray, another wants 64 shades of blue, another wants 64 shades of green, and another . . . well, you get the idea. There may not be enough colors to go around. This problem is solved by giving the active foreground window highest priority. A new message (WM_REALIZEPALETTE) tells a program when the palette is changing. *Windows* 3.0 uses a similar scheme.

The need for palette manipulation disappears when we get video boards that support full 24-bit color—8 bits each for the red, green, and blue primaries. It is widely believed among people familiar with these things that the 16 million colors available on such boards are more than adequate for the human eye. Indeed, current video monitors seem to respond adequately only up to about 6 bits of color resolution for each primary.

But until such boards are common, the GPI palette functions will be a good compromise.

NEW BITMAP FORMAT

OS/2 2.0 also supports a new bitmap format that is actually an extension of the previous format. All the bitmap functions in OS/2 2.0 will work with either format, and conversion between these formats is fairly trivial.

Under OS/2 1.1 and 1.2, bitmaps contain a minimal amount of information. There is a header area (represented by the BITMAPINFOHEADER structure) that provides the height and width of the bitmap in pixels, and the color organization (the number of color planes and consecutive bits per pixel). This is followed by a color table, containing 24-bit RGB (red-green-blue) color values for each color. The color table is followed by the bits themselves.

> The OS/2 2.0 Graphics Programming Interface includes a new bitmap format and a new collection of functions used for manipulating color palettes of video displays.

A new structure called BITMAPINFOHEADER2 contains additional information describing the bitmap. All the additional fields in this new structure are defined so that 0 is the default value.

The additional information includes a code for a compression scheme of the bitmap bits, a resolution of the image in pixels per meter, the number of colors actually used in the bitmap image and the number of important colors (this is usual when altering a palette for displaying the bitmap), and a code indicating any halftoning techniques used in the image. *Windows* 3.0 has a new bitmap format that is quite similar.

This additional information (and particularly bitmap compression) elevates the GPI bitmap format considerably. Once OS/2 gets rolling, I wouldn't be surprised to see Presentation Manager clip art available in the native GPI bitmap format. However, the only value currently defined for the compression scheme field is for an uncompressed bitmap.

Current versions of OS/2 have three functions that programs can use to draw a bitmap: WinDrawBitmap, GpiWCBitBlt, and GpiBitBlt. The first two require the program to have a handle to a bitmap. The bitmap is drawn on a specified presentation space. GpiBitBlt is the most versatile and can copy blocks of pixels between presentation spaces. For drawing a bitmap, GpiBitBlt requires that one of these presentation spaces be associated with a memory device context and that a bitmap be selected into this presentation space.

OS/2 2.0 adds a fourth function for drawing a bitmap: GpiDrawBits. This function does not require a handle to a bitmap. All you need is a pointer to a BITMAPINFO structure (this structure contains the BITMAPINFOHEADER structure plus the color table) and a pointer to an array of bits that define the image.

This sounds like such an obviously useful function, you may wonder why we had to wait for OS/2 2.0 to get it. Well, consider a 300- by 300-pixel bitmap with 256 colors. Such a bitmap appears about 3 inches square on an 8514/A. But it requires 90,000 bytes of data, and that's larger than a 64K segment. That's a problem in 16-bit OS/2 but certainly not in 32-bit OS/2.

OTHER NEW GPI FUNCTIONS

A couple of other new GPI functions are present in OS/2 2.0. The GpiFloodFill functions fill an area with a particular color or pattern. You specify a seed position and the function fills in one of two ways: until it reaches a boundary of a specific color or while it still encounters a surface of a particular color. GpiFloodFill is useful for implementing the "bucket of paint" function common in paint programs. Interestingly enough, flood filling is one of the very few capabilities of the *Windows* Graphics Device Interface (GDI) that previously could not be easily emulated in GPI.

There are limitations on graphics output devices with which you can use GpiFloodFill. In particular, only when the device driver is capable of reading pixels from the display surface can it support this function. Flood filling will not be possible on plotters and PostScript printers. New information that is available from DevQueryCaps lets applications know if an output device

supports GpiFloodFill.

The new GpiPathToRegion function is the fifth function that allows you to do something with GPI paths. (A GPI path is very similar to a PostScript path—it's simply a collection of lines and curves stored in memory rather than immediately drawn.) Under OS/2 1.1, you could call GpiStrokePath to stroke a path with a thick line, GpiFillPath to fill an enclosed area defined by a path with a particular color and pattern, or GpiSetClipPath to use the enclosed area for clipping. OS/2 1.2 added GpiOutlinePath to simply draw the outline of the path.

The new GpiPathToRegion function creates a GPI region from a path. You can then use the region for filling or clipping. This facility lets you create regions composed of objects other than rectangles.

> OS/2 2.0's GpiFloodFill, which lets you fill an area with a color or pattern, is useful for implementing the "bucket of paint" function common in most paint programs.

(This is the only other facility in *Windows*' GDI that could not be easily emulated in GPI.) You can also combine regions using logical operations (OR, AND, Exclusive-OR, and a difference). One use of this is determining whether two graphical objects overlap—a task that is currently not very easy.

It may sound as if the functionality of paths and regions overlap to a certain extent, and that is true. But paths are always defined in world coordinates and regions are defined in device coordinates. Interestingly enough, the original specification of the Presentation Manager allowed creating multiple paths and combining them with logical operations. The new GpiPathToRegion function doesn't quite add this same functionality, but it comes close.

The GpiSetLineWidth function has been documented since OS/2 1.0, but it hasn't been functional. You could only set a normal default line width. Under OS/2 2.0, you can also set a thick line width. The line width you set with this function is called the *cosmetic* line width and does not change under transforms. GPI has always allowed using a *geometric* line width for thick lines. Such line widths are specified in world coordinates and are subject to transforms.

MORE TIMELY INFORMATION

If you can't justify the cost of the OS/2 2.0 SDK and still want to keep current on what's happening as the beta versions of OS/2 2.0 become available, drop by the Programming forum of PC MagNet. ■

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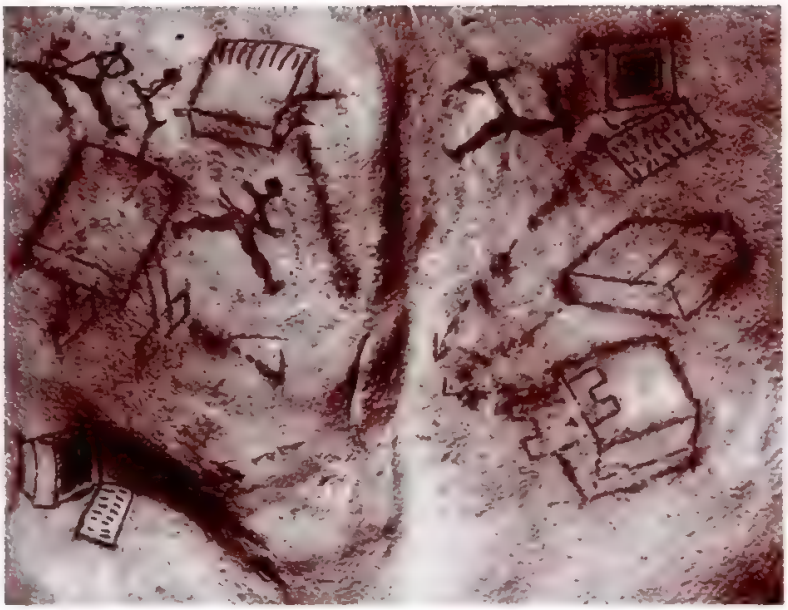

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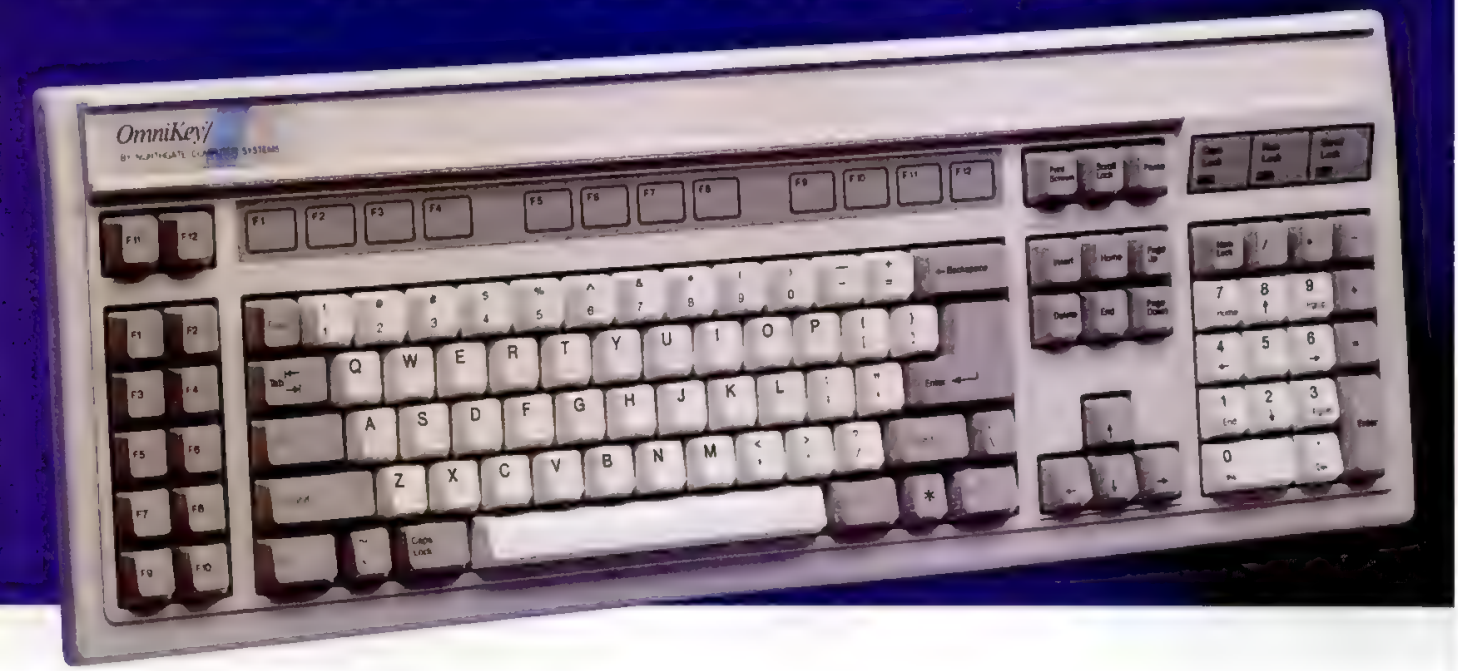

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by
Ray Duncan

Power Programming

Application Development Using OS/2 2.0's Memory Management

The addressing model and memory management techniques used by 32-bit programs under OS/2 2.0 represent a major leap forward on the path of software evolution for Intel 80*x*86 processors. They are also about as different from the models and techniques used in the previous versions of OS/2 as you could possibly imagine. Gone are the segments and selectors that were the indispensable currency of all memory transactions under OS/2 1.*x*. Instead, OS/2 2.0 relies almost completely on the 80386's paging unit to implement memory protection, memory sharing, and virtual memory.

In the last installment of this column, we looked at the basic mechanisms of memory address generation on the 80286 and 80386, at the architectural options available to designers of 80386 operating systems, and at the choices that were ultimately made in OS/2 2.0. In this issue, we'll examine memory management more closely from the point of view of a normal application program.

MEMORY MANAGEMENT BASICS

When you begin programming for OS/2 2.0 in its preferred 32-bit mode, you can forget about the small, medium, compact, large, and huge memory models that complicated life under DOS and OS/2 1.*x*. You can also forget about all the peculiar special pragmas, directives, and keywords for segmentation control that were commonly found in high-level-language compilers under those operating systems. A 32-bit application is much like an MS-DOS .COM program (which used the so-called tiny model, with CS=DS=ES=SS), except that the segment in which it lives is 4GB instead of 64K.

Within this 4GB segment, application code and data reside at the low end, and the operating system is mapped into the segment at the high end. Therefore, from the application's perspective, all jumps and calls are near, including operating system function calls. A 32-bit application never needs to be aware of segments at all and has no occasion ever to load a segment register explicitly. (Segment registers do get loaded behind the scenes whenever the application calls an operating system Application Program Interface (API) function that requires a switch in privilege levels, however.)

> ■ A flat memory model and 4 gigabytes have obvious advantages, but they can result in memory-protection and debugging difficulties too.

In OS/2 2.0, the application address space is limited to the first 512MB. This is further subdivided into three areas: the application's static code, data, and dynamically allocated private memory are at the bottom; dynamically allocated shared data and dynamic link (dynlink) library code and data (including the entry points for all operating system functions) are at the top; and unallocated memory is sandwiched in between. As additional private or shared memory is allocated (a 64MB minimum is enforced for each by the system), the two areas grow toward each other until free memory is used up, as diagrammed in Figure 1.

The first important thing to understand about memory management under OS/2 2.0 is that no matter what you might think you are allocating, releasing, or sharing, everything really happens in multiples of 4K—the standard page size for the 80386, 80486, and (presumably) 80586. The allocated chunk is referred to as a memory object, and the *handle* that is returned for an object is its 32-bit base offset. For example, if instead of using your high-level language's runtime library functions you call the operating system directly to allocate 200 bytes for an array, what you actually receive in return is the base offset of a 4K object. This fact has important implications both for system overhead and for debugging, as we shall see later.

The second crucial point to grasp is the distinction OS/2 2.0 draws between memory allocation and memory commitment. Allocation reserves a range of addresses in the 4GB linear address space, but it does not actually make those addresses valid and accessible. Commitment reserves physical memory and/or swap file space for part or all of a memory object on a page-by-page basis, thus causing the addresses within those pages to become valid. The first time a committed page is accessed, the system supplies a page full of zeros. You can commit an entire memory object at the same time you allocate it, but it is more reasonable to commit portions of the object only as they are needed, thus tempering the application's demand for system resources.

OS/2 2.0's facilities for memory protection are the third crucial issue with which you must become familiar. These are based on the capabilities of the 80386 paging unit. Each page can have one of these attributes: writable, read-only, or executable. On the 80386, executable is equivalent to read-only, and read-only or

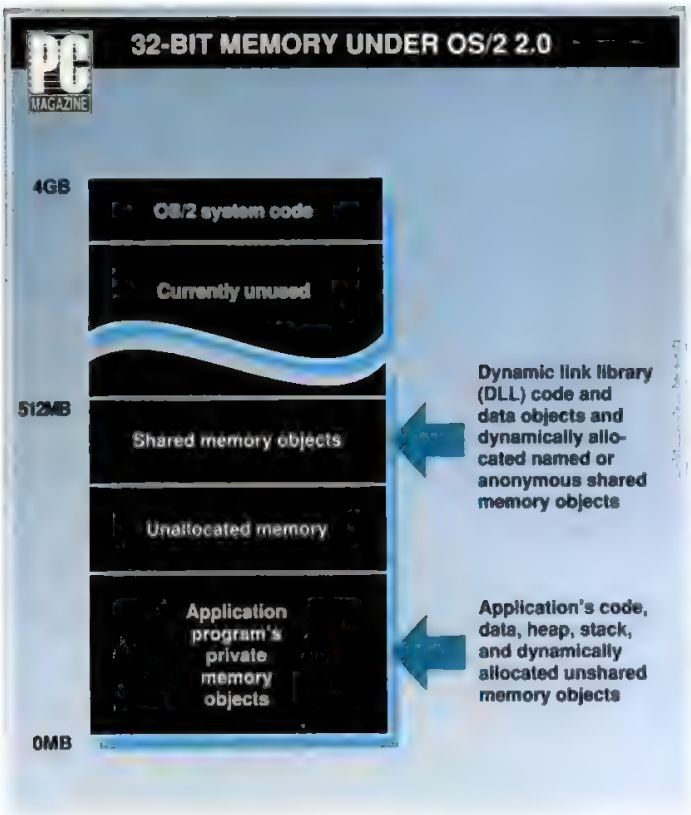

Figure 1: Under OS/2 2.0 a 32-bit application, dynlink libraries, and operating system occupy a single segment with a 4GB linear address space. The application's portion of the address space is divided into three sections: application code, static data, and dynamically allocated private data at the low end; dynamic link library code and data and dynamically allocated shareable data at the high end; and free memory in between.

writable pages are in fact executable. But the distinction is preserved in the software interface because it may be supported in hardware on future processors. In addition, each page can potentially be marked as a guard page; such pages are useful in the management of dynamically growing data structures (such as stacks) because a special type of exception is generated when they are accessed.

To review, let's consider all the possible consequences of a reference to a specific linear address. If the linear address lies within a page that has never been allocated, then a general protection (GP) fault (interrupt 0Dh) will occur. If the page has been allocated but not committed or not marked as a guard page, then a page fault (interrupt 0Eh) occurs. Both of these internal interrupts are fielded by the operating system's interrupt handlers and are reported to the application's GP Exception handler, if one has been registered; if the application has not registered a GP Exception handler, it is terminated, much as it would have been under OS/2 1.*x*.

When an address within a guard page is referenced, a Guard Page Exception is generated. If the application has not registered its own handler for this exception, the action of the system's default handler is to commit the page and then mark the next lower page within the memory object as a guard page. Finally, when an address within an allocated, committed page is referenced, the type of access is checked by the hardware against the page's access rights: writable, read-only, or executable. If the access is valid, it proceeds normally; if the access is not valid, a GP Exception occurs.

THE OS/2 2.0 MEMORY MANAGEMENT API

The memory management API functions available to 32-bit OS/2 2.0 applications are listed in Figure 2. They look fairly similar to the OS/2 1.*x* memory management API if you mentally substitute "memory object" for "memory segment." However, the similarities are actually more apparent than real. The somewhat different nature of memory protection, considerations of page commitment, and existence of guard pages guarantee that any OS/2 1.x memory management code you might already have on hand will not port to OS/2 2.0 without being completely rethought and rewritten.

A private memory object is allocated by a call to the 32-bit function DosAllocMem, which can be thought of as analogous to the 16-bit function DosAllocSeg. The pages within the object can all be committed at allocation time, or they can be selectively committed later by a call to the DosSetMem function. Access characteristics (read-only, read-write, executable, or guard) can also be specified at allocation time or on a page-by-page basis with DosSetMem, and a program can later retrieve commitment and access type information for a range of pages within an object with DosQueryMem.

A shared memory object is allocated with the 32-bit function DosAllocSharedMem, which is similar to the 16-bit function DosAllocShrSeg. As with DosAllocMem, the pages within a shared object can be committed and given access rights, either at the time of allocation or later, on a page-by-page basis, with DosSetMem. The shared object either can have a global

32-BIT MEMORY MANAGEMENT FUNCTIONS

Function name	Function action
DosAliasMem	Flag memory object as executable
DosAllocMem	Allocate private memory object
DosAllocSharedMem	Allocate shared memory object
DosFreeMem	Release memory object
DosGetNamedSharedMem	Get base address of named shared memory object
DosGetSharedMem	Make shared memory object addressable by the current process
DosGiveSharedMem	Make shared memory object addressable by another process
DosQueryMem	Get characteristics of memory object
DosSetMem	Set characteristics of memory object
DosSubAlloc	Allocate memory from local heap
DosSubFree	Free memory in local heap
DosSubSet	Create or reset size of local heap
DosSubUnset	Destroy local heap

Figure 2: In general, the 32-bit memory management functions available in OS/2 2.0 parallel those of Version 1.*x*, but differences in memory protection, page commitment, and the addition of guard pages will necessitate rewriting existing code.

The numbers outside.

name in the following form:

```
\SHAREMEM\objectname.extension
```

or it can be allocated as an anonymous object by setting the function call parameter for the object's name to a NULL pointer.

A named shared memory object can be accessed by another process with the API function DosGetNamedSharedMem (analogous to the 16-bit function DosGetShrSeg), which establishes addressability for the object and returns the 32-bit offset of its base. An anonymous shared object must be declared as givable or gettable when it is allocated, so that it can later be made addressable for another process with the functions DosGetSharedMem and DosGiveSharedMem. These last are equivalent in their behavior to the 16-bit functions DosGetSeg or DosGiveSeg.

Both private and shared memory objects are deallocated as a unit by calling DosFreeMem, which is analogous to the 16-bit function DosFreeSeg. After an object is freed, the linear addresses within the pages previously occupied by that object are no longer valid, the characteristics and access rights of those pages (guard, read-only, and so on) are no longer relevant, and any reference to those addresses causes a GP Exception.

The 16-bit function DosAllocHuge has no counterpart in the 32-bit API, because it is not needed: the memory objects created by DosAllocMem or DosAllocSharedMem can (theoretically, at least) be of any size up to the application's entire linear address space. Likewise, the 16-bit functions DosGetHugeShift, DosSizeSeg, DosLockSeg, DosUnlockSeg, DosR2StackRealloc, and DosMemAvail find no home in the 32-bit API; they have also been made irrelevant by the transition from segment-based to page-based memory management.

The 16-bit functions DosReallocSeg and DosReallocHuge have no successors in the 32-bit API either, but here the reasons are more subtle. Since the handle for a memory object is a 32-bit offset, which is susceptible to arithmetic manipulations, and pointers to routines or data within the object also take the form of absolute 32-bit offsets, the system cannot move memory objects around with impunity in order to resize them.

This is one of the few glaring deficiencies in page-based memory management when compared with segment-based management; the operating system can relocate data in a segment anywhere in physical memory at any time, since the selector portion of the data's virtual address is not arithmetically related to the data's linear address.

In any event, there are two possible workarounds for the absence of 32-bit counterparts for the DosReallocSeg and DosReallocHuge functions. First, you can initially allocate a memory object that is large enough for its worst-case requirements without committing any of it at allocation time; then use an exception handler, guard pages, and the DosSetMem function to commit increasingly large portions of the object, as necessary. Alternatively, when data outgrows its memory object, you can allocate and commit a new, larger object, copy the data from the old object to the new object, and then release the original object.

> Using the 80386's hardware paging unit for memory management has many advantages, especially in demand-paged virtual memory.

A PRACTICAL EXAMPLE

Figure 3 contains the source code for the program WC.C (Word Count). WC is a 32-bit application that demonstrates the simplest aspects of OS/2 2.0 memory management; it makes direct calls to the kernel API functions rather than using the standard C runtime library memory functions.

The WC program is run from the command line with the name of an ASCII text file as a parameter:

```
wc filename.ext
```

WC determines the size of the file, allocates a memory object of the same size, and reads the entire file into the object. WC then scans through the file's data, counting characters, words, and sentences, and reports the results on the standard output device.

WC helps clarify some of the fundamental benefits of the 32-bit programming environment and flat memory model: the size of memory objects, file I/O operations, and the range of contiguous addresses are all limited only by the 32-bit size of a pointer or count argument and by the total of the system's physical memory plus available space on the swap device. In effect, WC exploits the system's swap file as a linearly addressable work area. This avoids the need either to read the file in blocks and double-buffer the data or to use the C runtime library's much slower stream functions.

To build WC.EXE, use the command

```
CL386 WC.C
```

Naturally, in order to compile and link WC.C, you will need the OS/2 2.0 Software Development Kit (SDK), which includes the Microsoft 80386 32-bit C compiler (CL386), the Microsoft Linear Application Linker (LINK386), and the OS/2 2.0 32-bit API import library (OS2-386.LIB).

FLAT-MODEL TRADE-OFFS

With the material in this and in my preceding column securely under your belt, you can begin to discern some of the trade-offs inherent in OS/2 2.0's abandoning segmentation as a memory management tool. Using the 80386's hardware paging unit for memory management has many advantages, especially in the area of demand-paged virtual memory. However, there are also several capabilities—particularly those related to memory protection—that are lost forever because they are inherently associated with the segmentation paradigm. We've already discussed one of these (the inability to freely relocate memory objects in physical memory); however, there are also several other lost capabilities that I feel obliged to mention.

The most striking loss, at least from a debugging point of view, is the change from 1 byte to 4K granularity in memory allocations. In OS/2 1.*x*, you could get quite a bit of debugging assistance *for free* by putting arrays and other data structures into individual segments. If your program accidentally indexed outside the array or

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WC.C — COMPLETE LISTING

```
//  WP.C        Count characters, words, lines, and sentences in an
//              ASCII text file.  32-bit application for OS/2 2.0 SDK.
//              Word and sentence counting logic is simplistic and
//              is intended for demonstration purposes only.
//
//  Compile:    CL386 WC.C
//
//  Usage:      WC filename.ext
//
//  Copyright (C) 1989 Ziff Davis Communications
//  PC Magazine - Ray Duncan

#include <stdio.h>

#define INCL_DOS
#include <os2.h>

#define TAB     '\x09'                  // ASCII tab character
#define LF      '\x0A'                  // ASCII line feed
#define FF      '\x0C'                  // ASCII form feed
#define CR      '\x0D'                  // ASCII carriage return
#define BLANK   '\x20'                  // ASCII blank
#define EOFMK   '\x1A'                  // ASCII end-of-file mark

main(int argc, char *argv[])
{
    HFILE hhandle;                      // receives file handle
    FILESTATUS fstatus;                 // receives file information
    PBYTE fbuffer;                      // receives buffer address
    ULONG fptr;                         // index to buffer
    ULONG faction;                      // receives DosOpen action
    ULONG frlen;                        // receives DosRead length
    ULONG fchars;                       // chars. in file
    ULONG fwords = 0;                   // words in file
    ULONG flines = 0;                   // lines in file
    ULONG fsentences = 0;               // sentences in file
    ULONG wflag = 0;                    // TRUE if inside word

                                        // try and open file...
    if(DosOpen(argv[1],                 // filename from command line
        &fhandle,                       // receives file handle
        &faction,                       // receives DosOpen action
        0,                              // file size (ignored)
        0,                              // file attribute (ignored)
        FILE_OPEN,                      // fail if doesn't exist
        OPEN_ACCESS_READONLY | OPEN_SHARE_DENYWRITE,    // access mode
        NULL));                         // pointer to EAOP structure
    {
        printf("\nwc: can't open file %s", argv[1]);
        exit(1);
    }

                                        // get file size...
    if(DosQueryFileInfo(fhandle,        // file handle
        FIL_STANDARD,                   // information level 1
        (PBYTE) &fstatus,               // address of info structure
        sizeof(fstatus)));              // size of info structure
    {
        printf("\nwc: can't get file size");
        exit(2);
    }

    fchars = fstatus.cbFile;            // save file size

                                        // allocate memory object...
    if(DosAllocMem(&fbuffer,            // receives object offset
        fchars,                         // size to allocate
        PAG_COMMIT | PAG_READ | PAG_WRITE));    // commit backing store
    {
        printf("\nwc: can't allocate file buffer");
        exit(3);
    }

                                        // read the entire file
    DosRead(fhandle,                    // file handle
        fbuffer,                        // buffer address
        fchars,                         // length to read
        &frlen);                        // receives actual length

    DosClose(fhandle);                  // close the file

    for(fptr = 0; fptr < fchars; fptr++)    // scan the file
    {
        switch(fbuffer[fptr])           // check this character
        {
            case '.':                   // period found, count
                fsentences++;           // sentences (simplistic
                break;                  // assumption for demo)

            case LF:                    // line feed found, count
                flines++;               // lines, fall through

            case CR:                    // if first whitespace
            case BLANK:                 // character following
            case FF:                    // text, count words
            case TAB:
            case EOFMK:
                if(wflag) fwords++;
                wflag = FALSE;
                break;

            default:                    // if not whitespace
                wflag = TRUE;           // character, assume we
                break;                  // are traversing a word
        }
    }

    if(wflag) fwords++;                 // in case word at EOF

    DosFreeMem(fbuffer);                // release file buffer

    printf("\n%d characters, %d words, %d lines, %d sentences.\n",
        fchars, fwords, flines, fsentences);
}
```

Figure 3: WC.C is the source code for a practical example of a 32-bit OS/2 2.0 application that uses direct calls to the 32-bit memory management API. The program counts characters, words, lines, and sentences in ASCII text files.

structure, the segmentation hardware would immediately trap the reference and (if you were running your program under CodeView) the cursor would be put right on the source code line that produced the error. In OS/2 2.0, an array index out of bounds isn't going to be noticed by the hardware until (at best) it walks off the end of the last 4K page of the memory object that holds the array or structure. It may not be noticed even then if the memory object happens to be contiguous with another object.

The mapping of the entire application memory space by the CS selector and the inability of the paging hardware to distinguish between executable code and read-only data lead to yet another class of debugging problems. OS/2 1.*x*, which relied on the segmentation hardware, was able to segregate executable code from data in a very strict manner. If you tried to write to a code segment or execute a data segment, you would get an instantaneous GP fault. In OS/2 2.0, on the other hand, code and data are intermixed, and it is quite easy (inadvertently or otherwise) to create self-modifying code or to take a branch into a data area. In the latter case, you'll undoubtedly get an "invalid opcode" fault eventually; however, it's possible that some damage could be done before the fault is generated.

The last drawback to paged memory management is its increased system overhead. OS/2 1.*x* imposed approximately 100 bytes worth of hidden system overhead per segment, about half of which was swappable. This overhead consisted of the segment's descriptor, the tables used by the operating system to track segment ownership and segment aliases, the arena header used by the physical memory manager, and so on. In OS/2 2.0 there is also a hidden system overhead on the order of 100 bytes per memory object, which consists of page table entries, system structures to track page ownership and sharing, and so on. In addition, however, there is an unavoidable system memory overhead that results directly from the 4K granularity of allocations: on average, 2K of physical memory or swap file space is wasted per memory object.

Applications that allocate many small data objects or that are built up from many small logical code segments using compiler pragmas are likely to impose an inordinately heavy drain on system resources under OS/2 2.0. If you have an OS/2 1.*x* program that called the DosAllocSeg function for everything, you should probably redesign it to use the suballocation functions (DosSubSet, DosSubAlloc, and so on) in OS/2 2.0. In addition, if you really feel the need to control code locality and grouping directly, you should use the pragmas carefully to try and make the size of each code object slightly less than some multiple of 4K.

THE IN-BOX

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by
Gus Venditto

Windows

ASSOCIATING DATA FILES WITH PROGRAMS

Sometimes I can click on a text file in *Microsoft Windows* and immediately edit it; other times, I get a "Can't run file" error message. Are only certain kinds of files recognized by *Windows*?

Elizabeth Smith
Providence, Rhode Island

Microsoft Windows decides what to do with a file by reading file header information. *Windows* handles data files, including text, by referring to a table of extensions that it keeps in its WIN.INI file.

This file is the single most potent source of control for *Windows* operations, and it's readily changed with any text editor. Although most users open it only when they need to solve a problem with printers or a new program's defaults, it can be an easy way to customize *Windows*. Fortunately, *Windows* 3.0 is keeping most of the same WIN.INI conventions that appeared in earlier versions, so the following tip will apply to people running *Windows* 2 as well those who've already upgraded.

WIN.INI is organized into categories that hold definitions about the way a *Windows* session will run. These categories are defined with titles that appear in brackets. Under the subtitle [extensions], the Setup program has defined the filename suffixes that *Windows* will understand to be a particular program's data files. When you go through the installation for a *Windows* application, that program's install program adds its own program extensions to the section, just as the *Windows* Setup program inserted extensions for its calendar and paint programs.

If you're following the sensible practice of using filename suffixes to categorize information (maybe using abbreviations on documents to indicate which department the reports deal with), you'll want to store these suffixes in the WIN.INI file.

Let's say you've set up WIN.INI to associate an .LGL extension with *WordPerfect*. If you're in the MS-DOS Executive in *Windows* 2 or the File Manager in *Windows* 3, when you double-click on the filename MERGER5.LGL from a *Windows* directory listing, instead of getting a "Can't run MERGER5.LGL" error message, *Windows* will run *WordPerfect*. If the program and document are in the same directory, MERGER5.LGL will also load the file into *WordPerfect*. If it can't find the document in the program's path, *WordPerfect* will load, but you'll need to open the file first. When making the association, be sure to use the full path for where the program's stored.

- **ASSOCIATING DATA FILES WITH PROGRAMS:** Control your *Windows* sessions: Link data files with applications.
- **STARTING SESSIONS WITH FILE MANAGER:** Ease into *Windows* 3.0's icon-based design, using File Manager.

This is particularly useful if you use *Microsoft Excel* and share files with others who need .WKS and .WK1 spreadsheets. To set up *Excel* for an association with these files, enter this under the [Extensions] heading:

```
WKS=C:\WIN\EXCEL\EXCEL.EXE^.WKS
WK1=C:\WIN\EXCEL\EXCEL.EXE^.WK1
```

You can adapt this for any other programs.

Windows 3.0 provides an easier way to make these associations. In the File Manager, you can use the Associate option under the File menu to enter the directory and program name. It's simpler to do it that way, but it's more efficient to use a word processor and edit the WIN.INI file. If you don't mind using the *Windows* Notepad, you also can edit WIN.INI quickly by double-clicking on the filename.

There is still another way to get at WIN.INI if you are already using *Windows*, Version 3: it's the *Windows* Setup program. This deposits a nifty utility called SYSEDIT into the \WINDOWS\SYSTEM directory. Unlike the other system accessories, this doesn't rate an icon, so you have to look for it.

Click on it and you get four windows

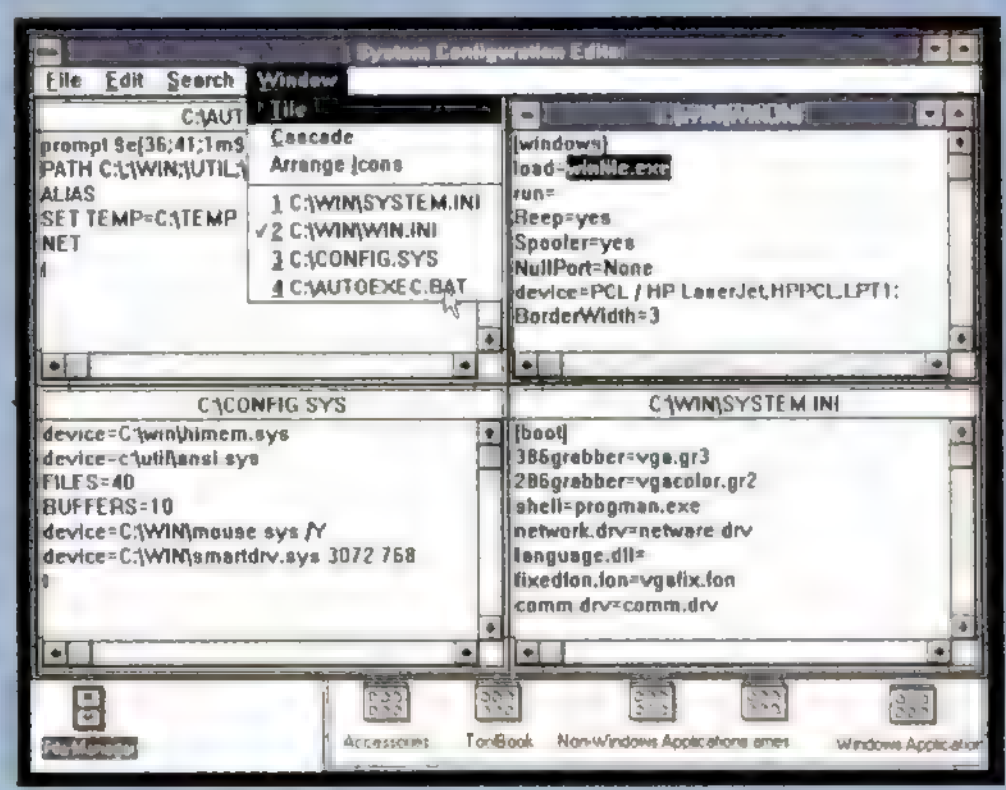

Figure 1: One of *Windows* 3.0's hidden jewels is SYSEDIT, a utility that the Setup program buries in the \SYSTEM subdirectory underneath the main *Windows* program. It's a quick way to edit your DOS and *Windows* configuration files.

(see Figure 1), each containing a system configuration file: CONFIG.SYS, AUTOEXEC.BAT, SYSTEM.INI and WIN .INI. There are very few commands; it's designed solely to let you check and update these files.

It's a handy program if you do a lot of tinkering with paths, devices, and other options. It's so handy that *Windows* 3 power users will probably want to include it as an icon in one of their folders so that it will be readily accessible.

To do that, look under the File menu in the Program Manager. Select New, then Add Program Item. In the dialog box you'll first be prompted for the name you want to use to identify the file. After you've made your selection, type

```
\WINDOWS\SYSTEM\SYSEDIT.EXE
```

Be sure to use the proper path for your *Windows* 3 files. Now any time you want to edit AUTOEXEC.BAT, you need only double-click on your new icon.

STARTING SESSIONS WITH FILE MANAGER

There are a lot of good things about *Windows* 3, but the icons and the lack of the MS-DOS Executive were giving us training problems. Fortunately, I found a way to step back to the way *Windows* used to look.

I changed the SYSTEM.INI file so that MSDOS.EXE was the shell instead of PROGMAN.EXE. We get the memory management improvements, but we don't have to learn a lot of new procedures.

Bill Gold
Hartford, Connecticut

PC MAGAZINE To each his own. The new screen design is easy to learn, but you're right that Version 3 can be made to look like *Windows* 2.1. You'd probably be better off leaving the Program Manager (PROGMAN.EXE) as the Shell and instead changing the load-setting in WIN .INI so that WIN.INI comes up after Program Manager. That way, you'll get the option of using Program Manager while MS-DOS Executive becomes the full screen. In your approach, MS-DOS Executive is the only choice; you'd have to path down and run the PROGMAN.EXE file in order to use any of the icons.

A better way to ease into *Win 3*'s icon-based design is to leave MS-DOS Executive on the trash heap and use the File Manager as the opening screen. That's easily done by changing WIN.INI so that the File Manager executable file (WINFILE.EXE) loads or runs. To do this, replace the load line in WIN.INI with

```
load=winfile.exe
```

Windows 3 will now start with the Program Manager as the main screen with File Manager running at the bottom as an icon. One advantage of this is that it speeds up the File Manager. Now, you'll have instant access to the directory tree, instead of waiting 10 or 15 seconds for it to read the disk. You pay for this faster access with a longer load time for *Windows*, but I find it's better to pay up front than later on.

OPENING WINDOWS

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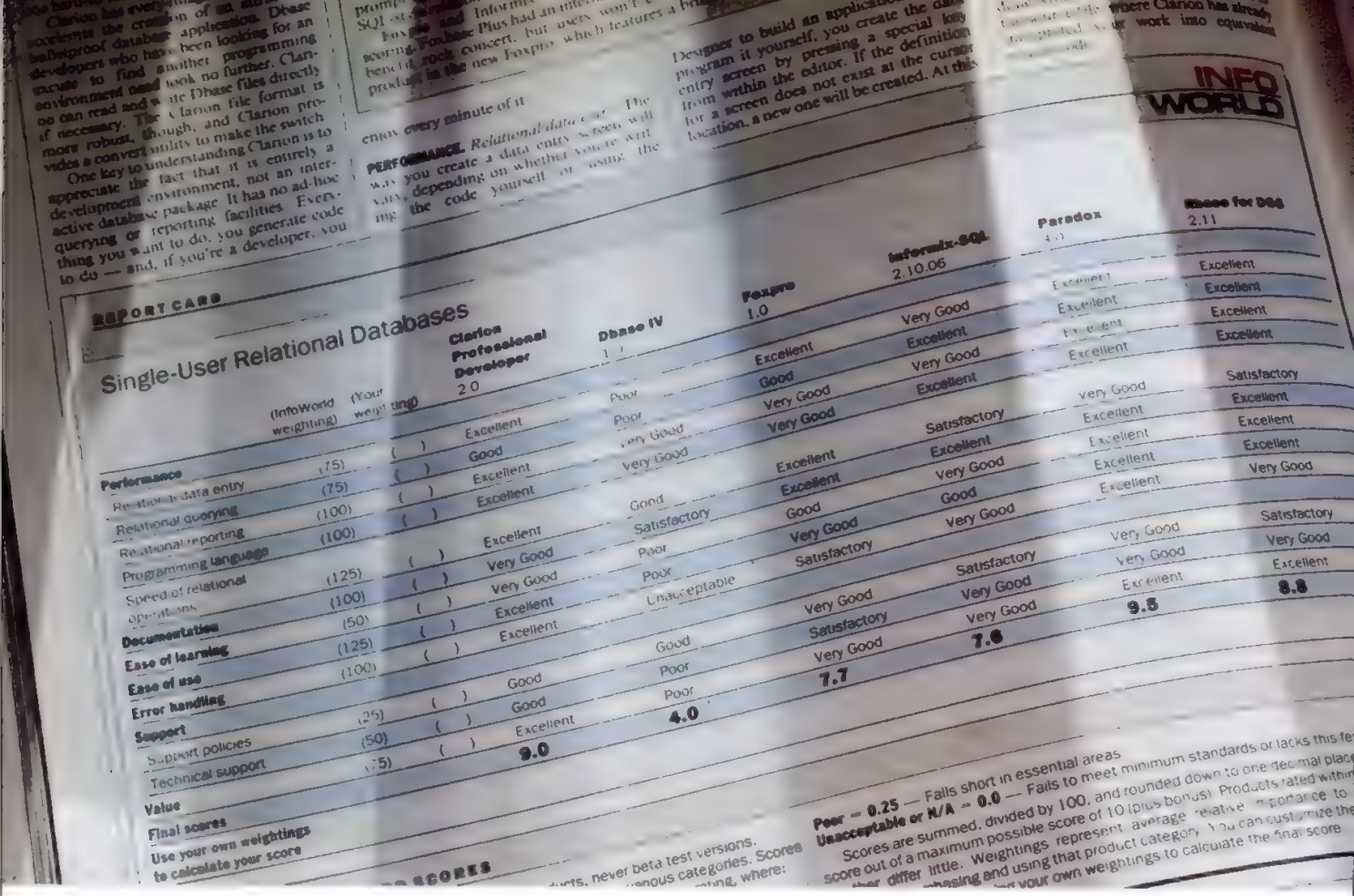

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edited by
Trudy Neuhaus

Databases

What's the difference between a flat-file and a multifile database? How can I determine which is better suited to a particular task?

Mark Lindquist
Richmond, Virginia

You are not the first to ask! I've received letters from many readers asking me the same questions. Sometimes it's valuable to explain a concept *and* to take a look at an example. Using *Reflex*, a recently selected Editor's Choice flat-file database as our example, we'll do just that.

One way to look at a database is as a set of relations between data: one-to-one, one-to-many, and many-to-many relations. The kind of relations you need to track will determine the kind of database you require.

A flat-file database is best suited for one-to-one relations. An address-book application containing names, addresses, and phone numbers is a good example. For every name there's one address and one phone number. A video store is a second example: for each tape, you could have the name of the movie, the location, running time, top three stars, and maybe a memo field with notes about the film.

You could use a flat-file database for one-to-many relations, but not without duplicating data. Let's suppose our video store wanted to record sales instead. If you choose a flat-file database for this task, you'll wind up storing a customer's name and address every time he purchases a tape. For repeat customers, this means the same data is stored over and over again.

Duplicating data has disadvantages. It not only wastes disk storage space, but if something changes (such as a customer's address), you must find and change all the instances of that entry. In addition, it's very easy to create two different versions of one data entry: simply enter Joe Smith on one invoice and Joseph Smith on another invoice. *You* know it's the same person, but the program won't; Smith will be counted as two customers. Then, if you count your customers by counting all the unique names, the total will be incorrect. In this case, data duplication defeats the purpose of keeping a database in the first place!

> ■ If you can't decide whether a flat-file or multifile database is best suited to the tasks at hand, exploring the strengths of a flat-file database may help you.

The efficient way to represent one-to-many relations is using multifile databases. In a multifile database, you have one table containing data about each customer: name, address, customer number, and so on. Another table holds the invoice information, including a *linking field* for the customer number. Using these types of databases, each customer's address data appears only once. Note that each separate table is a flat file.

REFLEX 2.0

One of the more-versatile flat-file databases is *Reflex*, from Borland International. This product has many advanced features more commonly found in the feature-rich (read, more-expensive) multifile databases. For instance, some flat-file databases let you enter or edit data *only* in the data-entry form and output a report. But *Reflex* also lets you view and analyze this data in other ways. Reporting options include cross-tabulation and graphing; a large selection of @ functions let you perform complex calculations; functions such as Compound Growth Rate, Future Value, and Present Value let you perform financial calculations.

A big difference between multifile databases and *Reflex* is that multifilers often have a "language," which lets you store a series of commands in a file and create reusable "programs." Until recently multifile database languages have been proprietary. But now a growing number of multifile databases are standardizing on SQL (Structured Query Language), a data-manipulation language. SQL assumes a multifile database; much of its power resides in the way it can relate different tables. Unfortunately, each implementation of SQL is quite different.

Reflex, on the other hand, has no language and no stored programs, and only sometimes does it have equivalents for some commands from other languages. For example, in the *R:base* implementation of SQL, the statement

```
PRINT DonorRpt WHERE ID IN (SELECT
 ID FROM DONATIONS WHERE AMOUNT >
 1000)
```

prints a report that's linked to the main donor list. It selects records to print, based on data drawn from the donations table. In this case, there is no *Reflex* equivalent since this operation spans two different databases (or tables).

The *R:base* command

```
SELECT ALL FROM VIDEOS WHERE NOTES
 CONTAINS "effects"
```

selects all fields from the VIDEOS database where the NOTES field contains the word "effects". To perform this same function in *Reflex*, you would bring up Records/Filter and put "..effects.." in the NOTES field of the Filter Conditions Table. Then choose Apply Filter and view the data in any way you please.

Note that the *R:base* syntax is English-like, but it produces output that scrolls away. The *Reflex* equivalent, on the other hand, lets you view, edit, print—and even graph—the results, without reselecting the data.

Here's another *R:base* command:

```
COMPUTE COUNT LNAME FROM MAILLIST
 WHERE LNAME EXISTS
```

The purpose of this command is to return the number of records that have something in the LNAME field. One way to do this in *Reflex* is to apply a filter by putting '' (a null string) in the LNAME field and then selecting Opposite of Conditions. Next, bring up the Crosstab View, hit F9, and choose @COUNT for the summary field. Press F9 in the next slot and pick *any* field to count. Bingo, you have a count. The nice thing is that if you want to break down this count by state, for example, you're already prepared. Just fill in State in the Row or Column slot.

In *askSam*, the (arcane) statement

```
Smith {IN} LName[ {sort
 FName[}{value}FName[ LName[
```

will list on-screen the first and last names of any records in which the last name contains Smith, sorted by first name. Its *Reflex* equivalent is to apply a filter with "..Smith.." in the LNAME field; next, sort on FNAME; and then, in the Mail Merge View, insert fields for FNAME and LNAME and view the result. Otherwise, you can bring up the List View and look at the FNAME and LNAME fields.

Paradox has a language, but for simple searching and querying such as you can do in *Reflex*, you would just use Query By Example.

CREATING A DATABASE

Here are a few tips that will come in handy if you're just beginning to work with *Reflex*. First, don't create any more fields than you have to. If your business has 40 products, don't create a field for each one. Rather, create a single field and simply call it PRODUCT.

To illustrate this, let's suppose you ignore this advice and create 40 fields for 40 products. Then you decide to generate a report that reflects the total sales for each product. You'll quickly find that you have to either create 40 separate reports, or create *one* report and modify it 40 times. In addition, assuming that each record references just one product, 39 fields will be wasted in each record, and you could accidentally fill in more than one of them in a single record. With a single PRODUCT field, on the other hand, you create one report, sorted by product, with a subtotal field that prints once for each product type. When your product line expands, you'll be glad you did it this way.

Some flat-file databases will require you to go through contortions to change the structure once there's data loaded. *Reflex* is unusual in that you don't have to get it perfect on the first try. Using the Field Properties dialog box, you can add, rename, or remove fields—even if you've already entered data. Most multifile databases are sophisticated enough to allow this. In *R:base*, for example, you can use the EXPAND and REMOVE commands to add and remove fields, and the CHANGE command to change field TYPE.

> In Borland's *Reflex* you can add, rename or remove fields that already contain data.

You can use spaces to name fields, but there are certain words and characters that are not allowed. For example, you can't name a field "Mutt And Jeff," because AND has a special meaning in *Reflex* formulas. But "Mutt & Jeff" is fine.

You don't have to assign field TYPEs (for example, numeric, text, date) at the outset; *Reflex* will assign these automatically when you start entering input. In addition, every text or memo field can contain up to the maximum number of characters, but you can set the number of characters to be displayed. You can also set the display format and justification in the same.

ENTERING DATA

You can enter data using the Form View or the List View. Bring up the Form View and you'll find there's already a form here. *Reflex* creates a default form as soon as you build a database. If you wish, you can enter Form Design mode to clean up the form by adding a header and moving and resizing the fields. *Reflex* puts a label next to every field—the label is the same as the field name. However, you can override this; just type another label.

Make use of floating formulas in *Reflex* 2.0: add them to a Form Design. Floating formulas aren't saved to disk, but they are useful. Suppose you keep a database of invoices, including when they were sent out and when they were paid. You can put a floating formula in the form that prints the age of an invoice *only* if it hasn't yet been paid. For example,

```
@IF( @ISNULL( PayDate), @FMT(
 @DAYSBTWN( InvDate, @TODAY()),
 *)+' days old', 'PAID')
```

In English, this statement says: If the PayDate field is empty, display the number of days between the invoice date and today's date followed by the words `'days old'`. Otherwise display the word `'PAID'`.

Most databases let you put calculated fields into reports. Some also let you put calculated fields into the database (that is, they are *Stored* in the database file) and show them in data entry forms. However, it's less common for a database to let you put calculated fields in forms without forcing you to store them in the database file on disk.

The List View is often better for entering numeric or tabular data. Bring up the view and adjust the column widths to your satisfaction. You may wish to move columns around: just Delete the old column, Insert a new column, and type the field name at the top. Deleting a column affects only the View; it does nothing to the database itself.

The '' key serves as a ditto mark. Press it to copy a particular field's data from the previous record to the current record. To add records to an existing database with List, hit the End key or Shift-F8 to go to the end of the database. There, you'll find a blank line where you can start typing.

You can add calculated columns to the display. They don't affect the stored database; they just show on the screen. For example, you might display a column that's the sum of three other columns.

DATA IMPORT/EXPORT

A database that can import and export data has definite advantages. It gives you the flexibility to move from a flat-file to a multifile database. You also have access to files from other database systems. *Reflex* translates *Reflex* 1.*x*, *Quattro*, *PFS:File*, *dBASE* (*II*, *III*, and *IV*), .DIF, *Lotus 1-2-3*, *Symphony*, *Paradox*, and ASCII-delimited files. If the program you want to export *to* isn't listed, try exporting to an ASCII file that your other program will read. *Reflex* lets you control how the ASCII file is created: it can be a fixed-format file, in

which a field is always found in the same location in each line; or it can be a *delimited* file, in which user-specified characters separate the fields. For instance,

```
Smith,Adam,100
```

is a file in which the fields are delimited by commas.

As you export a file, you can specify which fields to send out and add new fields calculated from the existing ones.

Once you arrange an import or export specification so that it works exactly right, you can save it for later use. This way, for example, if you export a summary of each week's data for import into another program, you can reuse the same specification.

Import will Create a database. If you tweak the result to match the structure of an existing database, you can then Append an imported database to an existing one.

DATA ENTRY VIA FORMULAS

Alt-F9 brings up a menu of *Reflex*'s @functions. Combined with the F9 key to bring up a list of fields, it's easy to enter complicated formulas without making typographical errors. To do this, bring up the Field Properties window and enter a formula for a particular field. The effect of this will depend on which of the following storage options you choose: you can put a value into all records that don't already have a local value; put a value into all records, replacing the local value; or remove the field from being Stored in the database and just calculate it on demand.

Actually, the best way to enter data using a formula is to take a field that's defined by a formula and convert all of the results into local values. As an example, let's have *Reflex* create a deck of cards and shuffle it. Create a new database with just one field, CARD. Bring up Field Properties and make CARD an Integer. Bring up Records/Generate Records, put CARD in the Field slot, check the Range box, fill in "From 0 to 51 by 1," and select Proceed.

Choose Field Properties again. Create a field called RANDOM, select Numeric for the field TYPE, and enter @RAND(). Then create a text field SUIT and enter

```
@CHOOSE(@INT(Card/13)+1, 'Clubs',
 'Hearts', 'Spades', 'Diamonds')
```

In English, this formula means: divide the Card number by 13, throw away the remainder, and add 1. This gives a number from 1 to 4. Then from the list of four values, choose the first, second, third, or fourth, depending on the number.

Next, create a text field called RANK and enter the formula

```
@IF( @MOD(Card, 13) < 8, @CHAR(
 @MOD(Card, 13)+50, @CHOOSE(
 @MOD(Card, 13)-7, 'T', 'J', 'Q',
 'K', 'A'))
```

If the remainder is less than 8 when the Card number is divided by 13, insert a number 2 greater than that remainder. Otherwise, insert the corresponding letter.

Bring up the List View and delete the columns for CARD and RANDOM. (To do this, select Shift-F3 to highlight columns, move to the column, and delete). Note that this does not delete them from the database, merely from the view.

Finally, choose Records, Sort, and sort on the RANDOM field. Each time you want to shuffle again, bring up Records/Update, choose to Update the RANDOM field, and choose Formula. The existing formula will appear. Then select Proceed, the program will sort on RANDOM again.

A TEST

The bottom line, of course, is this: can the database you have in mind handle the job you need done? To decide, take this test: Can you detail your data in tabular form, with each row corresponding to a record and each column corresponding to a field? If the answer is yes, you can use a flat-file database. And there are quite a few besides *Reflex*. Our June 26, 1990, issue also reviewed *PC-File*, *Professional File*, *Q&A*, *Reflex*, *RapidFile*, and *Superbase 2*. Go back and take a look.

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Research for this article was provided by Neil J. Rubenking, a contributing editor of PC Magazine.

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CIRCLE 285 ON READER SERVICE CARD

by
Craig Stinson

Spreadsheets

LOTUS 1-2-3 AND QUATTRO PRO COMPATIBILITY

Quattro Pro is generally compatible with *Lotus 1-2-3,* Release 2.2, but the two programs use different syntaxes to specify file links. And unfortunately, when *Quattro Pro* imports a *1-2-3* worksheet that uses file links, the file-linking formulas are not translated into *Quattro Pro*'s syntax.

The macro shown in Figure 1 converts the file-linking formulas in a *1-2-3,* Release 2.2, spreadsheet to the syntax used by *Quattro Pro*. After converting the file, you should save it with the extension .WQ1 to preserve the file links.

I keep this macro in my macro library as Alt-L.

Martin J. Eble
Cincinnati, Ohio

- **LOTUS 1-2-3 AND QUATTRO PRO COMPATIBILITY:** You'll need this macro to avoid errors when moving linked files across platforms.
- **COLUMN-WIDTH MACRO:** Macros that make it easy to set multiple column widths in *Lotus 1-2-3.*

PC MAGAZINE *Lotus 1-2-3* users who find file-linking (external reference) formulas useful have good reason to consider a switch to *Quattro Pro;* Borland's spreadsheet offers much more powerful file-linking features. But, as Mr. Eble points out, switching over from *1-2-3* is somewhat awkward.

1-2-3, Release 2.2, uses the following syntax for a reference to a cell in an external worksheet:

```
+<<file reference>>cell reference
```

Quattro Pro uses this syntax:

```
+[file reference]cell reference
```

In both examples, *file reference* is the full name of the external file, complete with the drive, path, filename, and extension. *Cell reference* can be a simple address or a range name. If it's a range name, the formula references the value in the upper-left corner of the named range.

When a Release 2.2 worksheet that contains external reference formulas is imported into *Quattro Pro,* the external reference formulas are not converted to *Quattro Pro*'s syntax. Instead, a *1-2-3* formula such as

```
+<<FILENAME.WK1>>A1
```

is translated by *Quattro Pro* into a formula based on the @@ function. The formula looks like this:

```
@@("<<FILENAME.WK1>>A1")
```

Each such formula returns ERR in the translated worksheet. Mr. Eble's macro avoids the possibility of having these error values returned by using *Quattro Pro*'s search-and-replace commands to transform the @@ formulas into the appropriate *Quattro Pro* syntax.

The macro performs four search-and-replace operations. Lines 1 through 3 issue *Quattro Pro*'s /Edit Search command and specify the entire worksheet as the range to be searched.

Lines 4 and 5 specify

```
@@("<<
```

as the first search string and

```
"+[
```

as the first replace string. Line 6 tells *Quattro Pro* to replace every occurrence of the search string with the replace string. The z and the {esc} in lines 4 and 5 remove any search-and-replace strings that may have been used previously.

So far, the macro has removed the characters that *Quattro Pro*'s translation routine placed to the left of the external file's name and converted the formula to a right-aligned label. The conversion to a label is

CONVERSION MACRO — COMPLETE LISTING

```
     A                    B                                  C
1  \l        {/ Audit;ReplaceRange}                  Issue Edit Search command and
2            {BACKSPACE}{HOME}.{END}                   Specify entire sheet
3            {HOME}~                                   as search range
4            {/ Audit;SearchString}z{esc}@@("<<~     Search for @@("<<
5            {/ Audit;ReplaceString}z{esc}"+[~       Replace with "+[
6            {/ Audit;Replace}a                      Replace all occurrences
7            {/ Audit;SearchString}                  Issue Edit Search command and
8            {BACKSPACE 6}>>~                        Search for >>
9            {/ Audit;ReplaceString}
10           {BACKSPACE 3}]~                         Replace with ]
11           {/ Audit;Replace}a                      Replace all occurrences
12           {/ Audit;SearchString}
13           {BACKSPACE 2}")~                        Search for ")
14           {/ Audit;ReplaceString}
15           {BACKSPACE 2}~                          Replace with nothing
16           {/ Audit;Replace}a                      Replace all occurrences
17           {/ Audit;SearchString}
18           {BACKSPACE 2}"~                         Search for "
19           {/ Audit;Replace}a                      Replace all occurrences
20                                                     with nothing
```

AVAILABLE ON PC MAGNET

Figure 1: This *Quattro Pro* macro uses a series of search-and-replace commands to translate *1-2-3*-style external references into the syntax of *Quattro Pro.*

necessary, because a formula such as

```
+[FILENAME.WK1>>A1")
```

would raise the hackles of *Quattro Pro*'s syntax checker and interrupt execution of the macro.

Lines 7 through 11 replace the greater-than signs on the right of the external reference formula with a closing bracket. Now each external reference cell is a right-aligned label with this general format:

```
+[FILENAME.WK1]A1")
```

Lines 12 through 16 replace ") with nothing, and lines 17 through 19 remove the label prefixes, converting each cell from a label back into a formula. All the external references are now written with valid *Quattro Pro* syntax.

Mr. Eble's last point is critical: you must run this macro from a macro library, not from the worksheet with the external reference formulas. The macro specifies the entire current worksheet as the search-and-replace range. If the macro lies within that range, it will be modified along with the external reference formulas.

Let me add that the macro is written in *Quattro Pro*'s command-equivalent macro language. If you're used to *1-2-3*'s approach to macro coding, the statements enclosed within braces may look a little strange to you. Each such statement codes for all the keystrokes required to carry out a single menu command, whether that command is six levels deep in the menu tree or right at the top.

Quattro Pro's macros can also be written as sequences of individual keystrokes, the way *1-2-3* macros are. But creating macros that code for each individual keystroke limits you to a particular menu tree. The command-equivalent approach has the advantage of working under any of *Quattro Pro*'s three menu trees—the *1-2-3*–compatible tree, the native *Quattro Pro* menu tree, or the *Quattro* 1 tree. If you're moving worksheets between *Quattro Pro* and *1-2-3*, you should probably write your *Quattro Pro* menus in the command-equivalent system. This way, even if you start out using *Quattro Pro* with the *1-2-3* menu tree, you'll be able to switch to *Quattro Pro*'s own menus later on without invalidating your macros.

COLUMN-WIDTH MACRO

Jim Strahan's macro for setting multiple column widths in *Lotus 1-2-3* (December 12, 1989) is awkward, because it requires you to enter the desired width in a cell of the relevant column; after you have reset the widths, you must delete this "temporary" row of cells. The macro in Figure 2 bypasses this limitation by prompting you to enter the width during execution. I keep the macro in the Release 2.2 macro manager so that I can set column widths on the fly.

Terry Stimpson
Whitby, Ontario
Canada

This macro does make it easy to set the widths of several columns at once, and unlike the /Worksheet Column Column-Range Set-Width command in *1-2-3*, Release 2.2 and Release 3, it doesn't require that all columns be of the same width. You just invoke the macro by typing Alt-W, then enter the desired width of each column in turn.

The macro's {get} statement "accumulates" the digits of the number separately, and the macro then drops each one into the appropriate cell—HUNS, TENS, or UNITS. When the user presses Enter, the values of HUNS, TENS, and UNITS are concatenated and dropped into the cell labeled WIDTH, where they are ready to be picked up by the /Worksheet Column Set-Width command in cell B15. Note that the {get} statement generates *labels*, not *values*, so the concatenation step (in B7) does not have to do a text-to-number conversion. When you're ready to quit the macro, press S.

To see how this macro works, try the following: Add a tilde to the end of the statement in B5, making it read

```
{get BASE}~
```

This will cause *1-2-3* to update the screen each time you press a key while the macro is running. (If you're using *1-2-3*, Release 3, you don't need to add this tilde.) As a test case, let's use 20 as the width. Put your cell pointer at B26 and press Alt-W. When you press 2, the macro deposits the digit in BASE; when you press 0, the macro deposits the 0 in BASE and moves the 2 to UNITS. When you press Enter, the macro deposits the concatenated number into WIDTH. The width of column B is now reset to 20, the cursor moves to column C, and the macro waits for more input.

I have a few suggestions for expanding this macro. First, you might want to allow the user to press the Right Arrow key to skip column widths that don't need to be adjusted; this way it will be easier to use the macro with nonadjacent columns. To make this modification, move to B7, insert a row, and add the following statement:

```
{if BASE="{RIGHT}"}{r}{branch \W}
```

Second, you can easily make this macro reset column widths to their defaults as well as set new widths. Just move to B7,

MULTIPLE COLUMN WIDTHS — **COMPLETE LISTING**

```
     A          B
1    \W         {let UNITS,"0"}
2               {let TENS,"0"}
3               {let HUNS,"0"}
4               {let BASE,"0"}
5    INPUT      {get BASE}
6               {if BASE="S"}{branch STOP}
7               {if BASE="~"}{let WIDTH,HUNS&TENS&UNITS}{branch SETIT}
8               {if HUNS<>"0"}{beep}{beep}{branch \W}
9               {let HUNS,TENS}
10              {let TENS,UNITS}
11              {let UNITS,BASE}
12              {branch INPUT}
13   SETIT      {if @VALUE(WIDTH)>240}{beep}{beep}{branch \W}
14              {if @VALUE(WIDTH)=0}{beep}{beep}{branch \W}
15              /WCS
16   WIDTH
17              ~{r}{branch \W}
18
19   STOP       {quit}~
20
21   HUNS
22   TENS
23   UNITS
24   BASE
```

Figure 2: This *1-2-3* macro resets a column width to a value that you enter during execution. It prompts you to enter a number for each successive column until you press S to quit.

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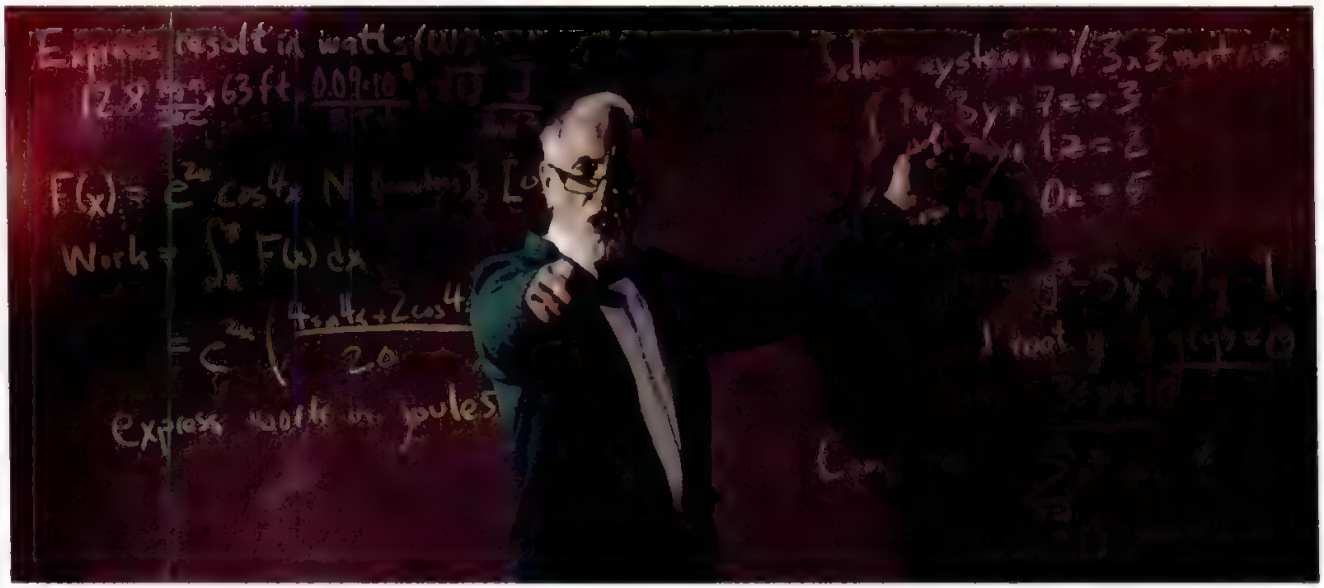

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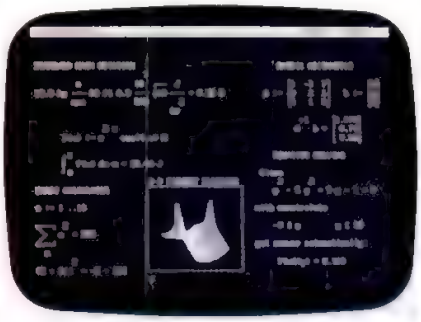

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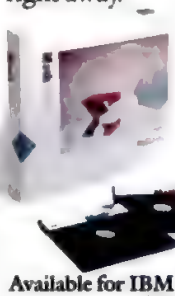

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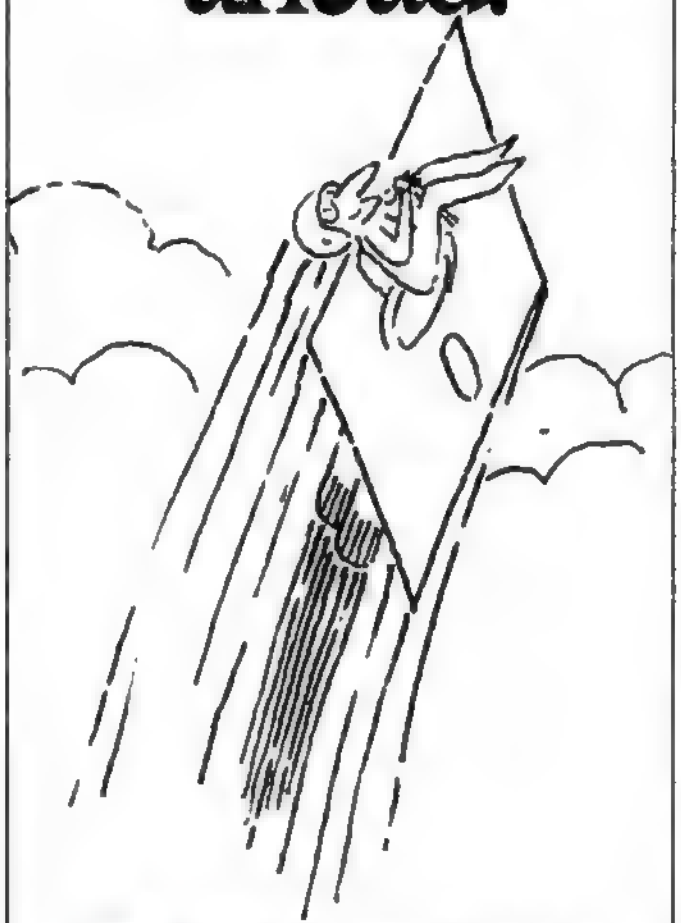

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MODIFIED COLUMN WIDTH MACRO — COMPLETE LISTING

```
     A          B
1    \W         {let UNITS,"0"}
2               {let TENS,"0"}
3               {let HUNS,"0"}
4               {let BASE,"0"}
5    INPUT      {get BASE}
6               {if BASE="{RIGHT}"}{r}{branch \W}
7               {if BASE="R"}/wcr~{r}{branch \W}
8               {if @UPPER(BASE)="S"}{branch STOP}
9               {if BASE="~"}{let WIDTH,HUNS&TENS&UNITS}{branch SETIT}
10              {if HUNS<>"0"}{branch BEEPER}
11              {let HUNS,TENS}
12              {let TENS,UNITS}
13              {let UNITS,BASE}
14              {branch INPUT}
15   SETIT      {if @VALUE(WIDTH)>240}{branch BEEPER}
16              {if @VALUE(WIDTH)=0}{branch BEEPER}
17              /WCS
18   WIDTH
19              ~{r}{branch \W}
20
21   STOP       {quit}~
22
23   BEEPER     {beep}{beep}{branch \W}
24
25   HUNS
26   TENS
27   UNITS
28   BASE
```

Figure 3: This modified macro adds options to Figure 2's macro and automates some of its steps.

insert a row, and add this statement:

```
{if BASE="R"}/wcr~{r}{branch \W}
```

Now, when the user presses R, the current column width will be reset.

Third, since the macro shown in Figure 2 has three lines that include {beep}{beep}{branch \W}, why not refer all three instead to a BEEPER subroutine? Just add a couple of new rows between the cell labeled STOP and the cell labeled HUNS, then insert the following code:

```
BEEPER      {beep}{beep}{branch \W}
```

Then replace the {beep}{beep}{branch \W} in cells B8, B13, and B14, with {branch BEEPER}.

Lastly, as designed, this macro is hazardous for inexperienced *1-2-3* users. It dies if you press keys other than r, R, s, S, Right Arrow, or 0 through 9. So if you plan to give it to others, you might add more-extensive error trapping.

One error-checking modification that's easy to make—and worth the trouble even if you just plan to use the macro in your own library—is to add an @UPPER function to the lines that check the value of BASE. With the default Lotus International Character Set (LICS) screen driver installed, *1-2-3* treats lowercase and uppercase letters as equivalent when evaluating {if} statements, but with the ASCII-No LICS driver, it doesn't. If you think you might ever want to switch to the ASCII-No LICS driver, you should modify the

```
{if BASE="R"}
```

and

```
{if BASE="S"}
```

statements to make them read

```
{if @UPPER(BASE)="R"}
```

and

```
{if @UPPER(BASE)="S"}
```

Figure 3 shows the column-width macro spruced up as described.

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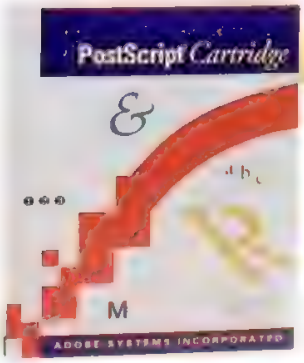

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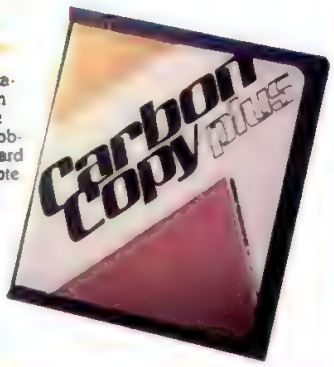

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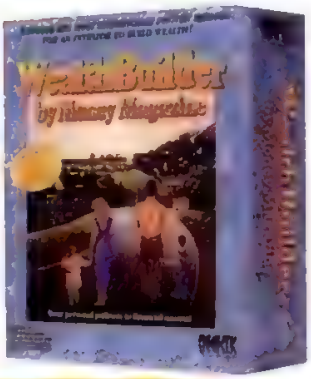

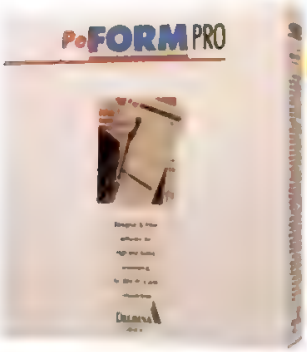

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Checkfree Technologies
Checkfree Express 2.0 ..... 19.
Contact Software Int'l
ACT! ..... 229.
Crosstalk Comm.
★ Crosstalk for Windows 1.0 ..... 117.
Dac Software
Dac Easy Accounting 4.1 ..... 79.
Dac Easy Bonus Pak 4.0 ..... 159.
Datastorm Tech.
Hot Wire ..... 68.
Procomm Plus 1.1 ..... 49.
Delrina Technologies
PerFORM 2.1 (w/Rebate) ..... 129.
PerFORM PRO ..... 269.
Delta Technology
Direct Access 5.0 ..... 59.
Dynamic Microprocessor Assoc.
pcAnywhere III 3.11 ..... 65.
Enable Software
Enable/OA ..... 409.
Fifth Generation
Fastback Plus 2.09 ..... 99.
FormalSoft
ProQube 1.03 ..... 59.
FormGen Corp.
FormGen Plus 5.0 ..... 106.
Formworx Corp.
Formworx with Fill & File 2.5 ..... 80.
Fox Software
Foxbase + Dev. Sys. 2.1 ..... 185.
FoxPro ..... 469.
Funk Software
Allways 1.0 ..... 80.
Sideways 3.21 ..... 37.
Gibson Research
Spinrite II ..... 69.
hDC Computer Corp.
★ FirstApps ..... 49.
★ Windows Express ..... 39.
Helix
Headroom 2.1 ..... 72.
IBM
Current ..... 355.
Intuit
Quicken 3.0 ..... 35.
Lord Publishing
Ronstadt's Financials ..... 99.
Lotus
Agenda 1.01 ..... 259.
Lotus 1-2-3 Rel. 2.2 ..... 339.
Lotus 1-2-3 Rel. 3 ..... 399.
Lotus 1-2-3 Upgrade Kit ..... 124.
Magellan 2.0 ..... 109.
Symphony 2.2 ..... New.
Meca
Managing Your Money 6.0 ..... 116.
Metro Software
Lasertwin All In One ..... 112.
Microcom
Carbon Copy Plus 5.2 ..... 105.
Relay Gold 4.0 ..... 161.
Micro Logic
InfoSelect ..... 54.
Microrim
R:Base Compiler ..... 579.
R:Base for DOS 3.0 ..... 456.
Microsoft
★ Excel 2.1 ..... 329.
★ Project 1.0 ..... New.
★ Windows 3.0 ..... 109.
Word 5.0 ..... 205.
★ Word for Windows ..... 309.
Works 2.0 ..... 89.
Multisoft
PC-Kwik Powerpak 1.5 ..... 70.
Super PC-Kwik 3.3 ..... 49.
Nolo Press
Willmaker 3.0 ..... 34.
Norton Lambert
Close Up Customer/Terminal ..... 119.
Close Up Support/ASC ..... 154.
Peachtree Software
Peachtree Complete III ..... 139.
Peachtree Cmpl. III Bonus Bdle ..... 219.
Peter Norton Computing
Norton Util. Advanced 4.5 ..... 79.
Norton Commander 3.0 ..... 85.
The Norton Backup 1.0 ..... 89.
Power Up Software
Calendar Creator Plus ..... 39.
Top Priority ..... 58.
Precision Software
★ Superbase 4 Windows ..... 439.
Prime Solutions
Disk Technician Advanced 6.0 ..... 88.
Disk Technician Professional ..... 36.
Primetime Software
Primetime Personal ..... 68.

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QMS
★ Ultrascript PC 2.1 ..... 129.
★ Ultrascript PC Plus 2.0 ..... 256.
Qualitas
386Max Professional ..... 75.
Quarterdeck Office Sys.
DESQview for Clipper ..... New.
DESQview 386 ..... 119.
QEMM 386 5.0 ..... 55.
QRAM ..... 45.
Reality Technologies
Wealthbuilder (by Money Mag.) ..... 135.
Reference Software
Grammatik IV 1.0 ..... 49.
Rightsoft
Rightwriter 3.1 ..... 45.
Rinearson Support Assoc.
Microsoft Word Companion Disk ..... 29.
Samna
★ Ami Professional ..... 299.
Softlogic Solutions
Software Carousel ..... 55.
Software Publishing
PFS: First Choice 3.02 ..... 105.
Professional Write 2.1 ..... 139.
Symantec
Q & A 3.0 ..... 219.
TimeLine 4.0 ..... 459.
The Software Toolworks
Backup Pro ..... 37.
Office Manager ..... 29.
Timeslips Corp.
Timeslips III 3.4 ..... 165.
Tops
Tops Network Bundle for DOS ..... 149.
Traveling Software
Laplink III ..... 85.
West Lake Data
Westlake Value Pak ..... 64.
WordPerfect Corp.
PlanPerfect 5.0 ..... 258.
WordPerfect 5.1 ..... 249.
WordStar U.S.A.
WordStar 6.0 ..... 256.
XTree Company
XTree Pro Gold ..... 69.

LANGUAGES

Borland International
Turbo C Prof. 2.0 ..... 164.
Turbo Pascal Prof. ..... 169.
Microsoft
Basic Prof. Dev. Sys. 7.0 ..... 329.
C Compiler 6.0 ..... 289.
QuickC 2.0 ..... 63.
Peter Norton
Norton Editor 1.3 ..... 47.

by
Craig L. Stark

The Working Word

The need to shift among several word processors when working on this column has made me much more sympathetic to light bar menu systems. Unless you use a given software package so regularly that you don't consciously have to try and recall its command keystroke combinations, a point-and-shoot approach, albeit indirect and theoretically inefficient, may actually save time—and certainly frustration!

A user-modifiable start in this direction for *WordPerfect* 5.0 users has been provided by Richard Anderson and by frequent contributor Jordan Hodgson.

LIGHT BAR MENUS

The *WordPerfect* 5.0 macro language can be used to create moving light bar menus. The generic macro structure that creates such a menu is shown in Figure 1; to use it you must specify the *action* to be performed by each choice.

A quick run through the macro structure will reveal how it works. The number assigned to {VAR 1} enables the macro to keep track of any light bar movement you make. A menu box is then put on the screen, and a nested {IF} statement uses the initial variable assignment to paint the top choice in reverse video. Note that spaces—which show up as centered dots in the macro editor—have been added to the wording of shorter choices to keep all bars of uniform length, and that the wording must be rewritten when the painting is done.

- **LIGHT BAR MENUS:** Now you can add point-and-shoot to *WordPerfect* 5.0.
- **MORE FONTS IN 5.1:** If you have enough memory, then you can break the 32-font setup limitation.

After the {IF} statement, a {CHAR} command with an empty message enforces a single keystroke pause without altering the menu box. You now have three options: press the first letter of any option to implement it directly; press Enter to choose the highlighted item; or move the bar with the Up or Down Arrow keys. If you choose the third option, the first and second options always remain available, because the macro continues to loop back to the {IF} structure and the value of {VAR 1} is constantly updated.

The single response key that you choose is tested by the ensuing {CASE} statement. Provision is made for both upper- and lowercase letters, and if an appropriate letter is pressed, execution goes directly to the action selection routines at the bottom of the macro. If a key not included in the {CASE} tests is pressed, execution falls through to the lines following the {CASE} statement. A beep is sounded, and an error message is posted on the bottom screen row. After two seconds, the message is erased by the statement {PROMPT}{Del to EOL}~, and {GO}getkey loop~ enables a new try.

If you hit Enter, execution jumps to {LABEL}implement~, where a {CASE} test uses the current value of {VAR 1} to pick out the proper label.

BAR.WPM — **COMPLETE LISTING**

```
{ON CANCEL}{GO}cancel~~
{ASSIGN}1~1~

{PROMPT}
{^P}{^A}{^A}
{^P}{^A}{^B}
{^P}{^A}{^C}        First choice
{^P}{^A}{^D}        Second choice
{^P}{^A}{^E}        Third choice
{^P}{^A}{^F}
{^P}{^A}{^G}

{LABEL}getkey loop~
{IF}{VAR 1}=0~
            {PROMPT}{^P}{^G}{^E}{^R} Third choice  {^S}~
            {ASSIGN}1~3~
{ELSE}{IF}{VAR 1}=1~
            {PROMPT}{^P}{^G}{^C}{^R} First choice  {^S}~
{ELSE}{IF}{VAR 1}=2~
            {PROMPT}{^P}{^G}{^D}{^R} Second choice {^S}~
{ELSE}{IF}{VAR 1}=3~
            {PROMPT}{^P}{^G}{^E}{^R} Third choice  {^S}~
{ELSE}{IF}{VAR 1}=4~
            {PROMPT}{^P}{^G}{^C}{^R} First choice  {^S}~
            {ASSIGN}1~1~
{END IF}{END IF}{END IF}{END IF}{END IF}

{CHAR}2~~
{CASE}{VAR 2}~
            {Up}~dec~{Down}~inc~{Enter}~implement~
            f~choice1~F~choice1~s~choice2~S~choice2~
            t~choice3~T~choice3~~

{PROMPT}{BELL}Inappropriate key.  Try again.~
{WAIT}20~
{PROMPT}{Del to EOL}~
{GO}getkey loop~

{LABEL}dec~
            {ASSIGN}1~{VAR 1}-1~{GO}repaint~

{LABEL}inc~
            {ASSIGN}1~{VAR 1}+1~

{LABEL}repaint~
            {PROMPT}{^P}{^G}{^C} First choice  ~
            {PROMPT}{^P}{^G}{^D} Second choice ~
            {PROMPT}{^P}{^G}{^E} Third choice  ~
            {GO}getkey loop~

{LABEL}implement~
{CASE}{VAR 1}~
            1~choice1~2~choice2~3~choice3~~

{LABEL}choice1~
            {DISPLAY OFF}{DISPLAY ON}{action 1}{QUIT}

{LABEL}choice2~
            {DISPLAY OFF}{DISPLAY ON}{action 2}{QUIT}

{LABEL}choice3~
            {DISPLAY OFF}{DISPLAY ON}{action 3}{QUIT}

{LABEL}cancel~
            {DISPLAY OFF}{DISPLAY ON}
```

Figure 1: This generic macro gives you the basis for adding point-and-shoot menus to *WordPerfect* 5.0.

An Up or Down Arrow diverts to the dec or the inc label, where the value of {VAR 1} is lowered or raised by one. The `repaint` routine next rewrites the menu box wording without reverse video to eliminate the current light bar. Execution loops back up to the {IF} complex, and the new value of {VAR 1} causes the proper item to be highlighted.

The three available choices are represented by the {VAR 1} values 1, 2, and 3. Note that the {IF} structure also tests for 0 and 4. The value 0 allows you to press the Up Arrow key to move directly from the top to the bottom menu line, while 4 lets you go from the bottom to the top line with the Down Arrow key. Thus, for example, when the top item is highlighted after the macro is first run, an Up Arrow changes {VAR 1} to 0, via the dec label, so that the {IF} test causes the bottom item to be painted. The value of {VAR 1} is then reset to 3. If you now press Enter, this value will cause the {CASE} testing in {LABEL}implement - to select the correct action. When you hit F1 to exit the menu, the opening {ON CANCEL} diverts to {LABEL}cancel - to clear the menu from the screen.

Richard Anderson
Oakland, California
Jordan V. Hodgson
Torrance, California

PC MAGAZINE As Mssrs. Anderson and Hodgson indicated, this is a *generic* macro, not a finished product. It is, however, a well-thought-out starting point. You may want to add more choices, give them more-appropriate names, and, of course, you must add the necessary command keystrokes to the [action] sections of the macro. Only a single-level menu is presented—nothing like the full-blown treatment implemented in *WordPerfect* 5.1—but WP power users should be able to extend the technique considerably. Naturally, when you've developed your own version of BAR.WPM you will also want to make it callable by means of a single-key macro.

MORE FONTS IN 5.1

You can encounter a font limit when using *WordPerfect* 5.1. The maximum number of fonts that can be selected using either the + or the * key is 32, regardless of how much printer memory is installed. While the *WordPerfect* 5.1 manual warns of this limitation, it is a serious matter for HP LaserJet II owners with 1.5MB or more memory who are used to downloading more than 32 soft fonts in *WordPerfect* 5.0.

Fortunately, as demonstrated step by step in Figure 2, there is a solution that will allow HP LaserJet Series II—and possibly other laser printer—users who upgrade to *WordPerfect*, Version 5.1, to bypass the 32-font limit and download as many soft fonts as their printer's memory will allow.

Paul Crutchfield
Spokane, Washington

DOWNLOADING EXTRA SOFT FONTS IN WORDPERFECT 5.1

```
cd\wp51                                  log onto your WP directory
PTR <enter>                              enter printer program
<shift><F10>                             File to be retrieved:
<F5>                                     Filename pattern:  C:\WP51\x.all
x.all                                    select your x.all file
<enter>
select your printer
<enter>
select resources
<enter>
select soft fonts (Xb)
<space bar>
<right 2>                                to "32" under "Maximum Fonts"
enter new value                          type in quantity desired
<enter>
<F7>
<F7>
<F7>                                     Save file Y
<enter>
<enter>                                  File to be saved:  C:\WP51\x.all
replace c:\WP51\x.all
<Y>
<Y>                                      exit printer program
<WP>                                     enter WordPerfect 5.1
<shift><F7>                              display printer menu
<S>                                      select printer
<A>                                      additional printer
<S>                                      select your printer
<enter>                                  select filename
<Y>                                      replace *.prs
<F7>                                     return to edit menu
<6>                                      type in path for downloadable fonts
<enter>
<4>                                      cartridges and fonts menu
<down 2>                                 choose soft fonts
<2>                                      change memory quantity, if necessary
<enter>
<enter>
<enter>                                  note new quantity of fonts available
                                         in upper right screen corner
<F7>
<F7>
<F7>
<5>                                      change base font, if necessary
<enter>
<F7>
<5>                                      delete duplicate printer
<F7>
<F7>                                     resume your regular work!
```

Figure 2: By following this step-by-step procedure, you can make Version 5.1 of *WordPerfect* allow the selection of more than 32 fonts (assuming adequate printer memory) for the HP LaserJet II.

PC MAGAZINE Anyone who has struggled with the need to reduce the size of his .ALL printer driver file in *WordPerfect* 5.1 in order to keep his Bitstream font generating program happy has probably already developed either a love or a hate relationship with WP's PTR.EXE. I find the whole "automatic" printer installation procedure in WP—to say nothing of modifying the drivers with PTR—a frustrating nuisance. Perhaps when the documentation for PTR 5.1 is ready it will be easier to understand what's going on. In any event, however, if you use a lot of fonts and can fit more than 32 into your LaserJet II, Mr. Crutchfield's solution will do the job.

TIPS FROM WORKING WORDSMITHS

Tell fellow users about your latest word processing tips, and we'll pay you $50 for any tips we print. Please send your letter on a disk along with a printout. Mail your contributions to The Working Word, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). ■

by
Neil J. Rubenking

User-to-User

IN ANY CASE

The IF batch command is useful, but it's exceedingly irritating that all string comparisons are case sensitive. How often have you written batch code like this:

```
IF %1 == LOTUS GOTO do_lotus
IF %1 == lotus GOTO do_lotus
IF %1 == Lotus GOTO do_lotus
```

in order to account for variations in input? And all this code still can't deal with typos, such as LOtus.

There is a nifty way to have DOS ignore the case of your parameters. The trick is to create an environment variable whose *name* is the parameter. Put it on the *left* side of the equal sign in a SET command, then see if the test string matches any environment variable. For example:

```
SET %1=xx
IF .%LOTUS%==.xx GOTO do_lotus
IF .%1==.123     GOTO do_lotus
... (contents of batch file) ...
SET %1=
```

The first SET command creates an environment variable—it can have just about any value. The next line tests whether a variable named *lotus* (regardless of case) has that same value. To make this technique work reliably, you must purge the variable before leaving the batch file.

Watch out for numeric parameters—the text %123% won't expand correctly for the comparison, since DOS gives precedence to the %1 part of it. In that case, simply do a direct comparison, as in the third batch line above.

Dan Rollins
La Crescenta, California

In a previous column, we showed you a technique for making an uppercase copy of any batch parameter. It involved saving the PATH, setting the PATH to the value of the parameter, and setting another environment variable to the new PATH; DOS always changes the PATH to uppercase. This works, but it's complicated and requires lots of environment space—at least enough for two copies of your PATH.

- **IN ANY CASE:** You can make case-insensitive comparisons in your batch files if you do the comparison backwards.
- **FINE-TUNE YOUR SYSTEM:** Here's an easy way to switch among many different sets of CONFIG.SYS and AUTOEXEC.BAT files.

We've also shown you how to use a FOR command to allow any *specific* set of variations in upper- and lowercase. For example:

```
FOR %%v IN (FOOBAR Foobar foobar)
 DO IF '%1'=='%%v' GOTO foobar
```

However, this method won't catch an unanticipated variation like FOobar.

The technique described above doesn't *change* the parameter to uppercase, but it correctly tests for *any* combination of upper- and lowercase. Figure 1 is a demonstration: type TEST followed by the words "PC Magazine" or "pC mAgAzInE". As long as you spell the words correctly, it will accept your parameters regardless of case.

TEST.BAT — COMPLETE LISTING

```
ECHO OFF
SET %1=xx
IF NOT .%PC%==.xx GOTO nogood
SET %2=yy
IF NOT .%magazine%==.yy GOTO nogood
ECHO Good, you entered
ECHO  "PC Magazine"
GOTO end
:nogood
ECHO Not good, you didn't enter
ECHO  "PC Magazine"
:end
SET %1=
SET %2=
```

Figure 1: TEST.BAT demonstrates a technique for checking command-line parameters regardless of whether they're upper- or lowercase.

FINE-TUNE YOUR SYSTEM

Michael J. Mefford's CONFIG.CTL utility (from the November 29, 1988, Utilities column) is a great way to customize your CONFIG.SYS on the fly. However, how many of us can remember which parameters to reconfigure for each application? I sure can't, so I wrote RECONFIG.BAT (Figure 2).

As an engineer, my day may involve switching back and forth between any number of applications: computer-aided design, word processing, statistical process control (SPC), database, spreadsheet, desktop publishing, and so forth. And each of these applications may benefit from a different CONFIG.SYS. For example, the SPC program makes good use of a RAM disk, but the amount of memory that takes prevents you from using the spreadsheet.

I used to manually replace my basic CONFIG.SYS with another file (named mnemonically for the specific application) and reboot each time I changed applications, but as you can imagine, this method rapidly grew tiresome. RECONFIG.BAT automates most of the necessary keystrokes. The syntax is

```
RECONFIG filespec
```

The batch file copies the configuration file, matching parameter %1 to CONFIG .SYS, and then performs a warm boot. It looks for configuration files in the subdirectory C:\SYS. If RECONFIG.BAT can't find the intended file, it displays an error message and lists the available configuration files. If you call RECONFIG with no parameter or with an /h, it will display help, show the current CONFIG.SYS, and list the available files. Calling it with the parameter ?

RECONFIG.BAT COMPLETE LISTING

```
@ECHO OFF
CLS
IF "%1" == "" GOTO help
IF "%1" == "?" GOTO showfile
IF "%1" == "/h" GOTO help
GOTO start
:help
ECHO Name:  RECONFIG.BAT   Author:  Kerry L. Nye
ECHO *
ECHO Syntax:  RECONFIG [filespec] [?] [/h]
ECHO *
ECHO This batch file will reconfigure CONFIG.SYS to the
ECHO configuration specified in "filespec".  It copies a
ECHO configuration file to CONFIG.SYS, copies an auto-
ECHO executing batch file to AUTOEXEC.BAT, and performs a
ECHO warmboot.  It checks to see that both files exist in
ECHO the subdirectory where valid application-specific
ECHO CONFIG.SYS and AUTOEXEC.BAT files are maintained.  If
ECHO not, it displays the files in the subdirectory, with an
ECHO appropriate error message.  Calling RECONFIG without a
ECHO parameter or with parameter "/h" will display this
ECHO help, the current CONFIG.SYS and AUTOEXEC.BAT, and the
ECHO configuration file subdirectory.  Calling RECONFIG with
ECHO parameter "?" displays the current CONFIG.SYS and
ECHO AUTOEXEC.BAT and the configuration file subdirectory.
ECHO RECONFIG accomplishes a warmboot by calling
ECHO WARMBOOT.COM.  Consult the July 1989 PC Magazine
ECHO User-to-User column for information on WARMBOOT.COM.
ECHO *
PAUSE
GOTO showfile
:start
IF EXIST C:\SYS\%1.SYS GOTO onefile
ECHO %1.SYS does not exist on C:\SYS
GOTO nofile
:onefile
IF EXIST C:\SYS\%1.BAT GOTO yesfile
ECHO %1.BAT does not exist on C:\SYS
GOTO nofile
:yesfile
COPY C:\SYS\%1.SYS C:\CONFIG.SYS /V
COPY C:\SYS\%1.BAT C:\AUTOEXEC.BAT /V
WARMBOOT
GOTO END
:showfile
CLS
ECHO The current CONFIG.SYS is:
ECHO *
MORE < C:\CONFIG.SYS
PAUSE
ECHO The current AUTOEXEC.BAT is:
ECHO *
MORE < C:\AUTOEXEC.BAT
PAUSE
:nofile
ECHO *
ECHO The valid configuration files are:
DIR C:\SYS\*.SYS /W
PAUSE
ECHO The valid autoexec files are:
DIR C:\SYS\*.BAT /W
:end
```

Figure 2: Customize your configuration with multiple sets of CONFIG.SYS and AUTOEXEC.BAT files, and use this batch file to switch among them automatically.

shows the current CONFIG.SYS and lists the available files.

RECONFIG.BAT benefits from a suggestion in the July 1989 User-to-User column. RECONFIG calls the WARMBOOT .COM file presented there to reboot the computer after copying the new configuration file onto CONFIG.SYS.

This way you can keep several alternate configurations for specific applications available. You don't have to remember the details of each, you don't have to type every keystroke, and you don't have to remember to reboot.

Kerry L. Nye
Columbia, Missouri

I use a very similar batch to set up different operating environments. I find that almost every change in CONFIG.SYS also requires a change in AUTOEXEC.BAT, so I keep a set of alternate AUTOEXEC files to match the different CONFIGs. I took the liberty of changing RECONFIG.BAT to do the same. Now it checks to be sure *both* the alternate AUTOEXEC and CONFIG are present, and shows listings of both.

Be sure to store your everyday AUTOEXEC and CONFIG in the SYS directory too. Just call them EVERYDAY.SYS and EVERYDAY.BAT—now the command RECONFIG EVERYDAY will return your system to normal. Once you've created all of the alternate .SYS and .BAT files, use ATTRIB to make them Read-Only. That will protect them from accidental changes.

For those who missed WARMBOOT in the July 1989 issue, Figure 3 lists WARMBOOT.SCR. Type the script file

WARMBOOT.SCR COMPLETE LISTING

```
N WARMBOOT.COM
A 100
MOV BX,1234
MOV AX,0040
MOV DS,AX
MOV [0072],BX
JMP FFFF:0000

RCX
11
W
Q
```

Figure 3: For those who missed WARMBOOT.COM before, this little DEBUG script will create it.

carefully, leaving a blank line before the RCX line and after the final Q. Now enter the command

```
DEBUG < WARMBOOT.SCR
```

to create WARMBOOT.COM. Store the resulting file in a directory that's on your PATH.

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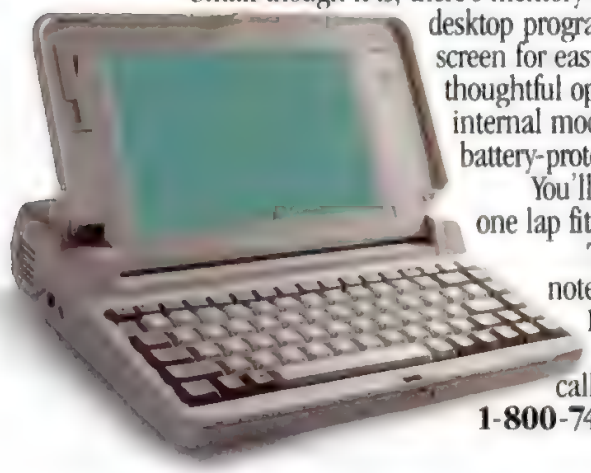

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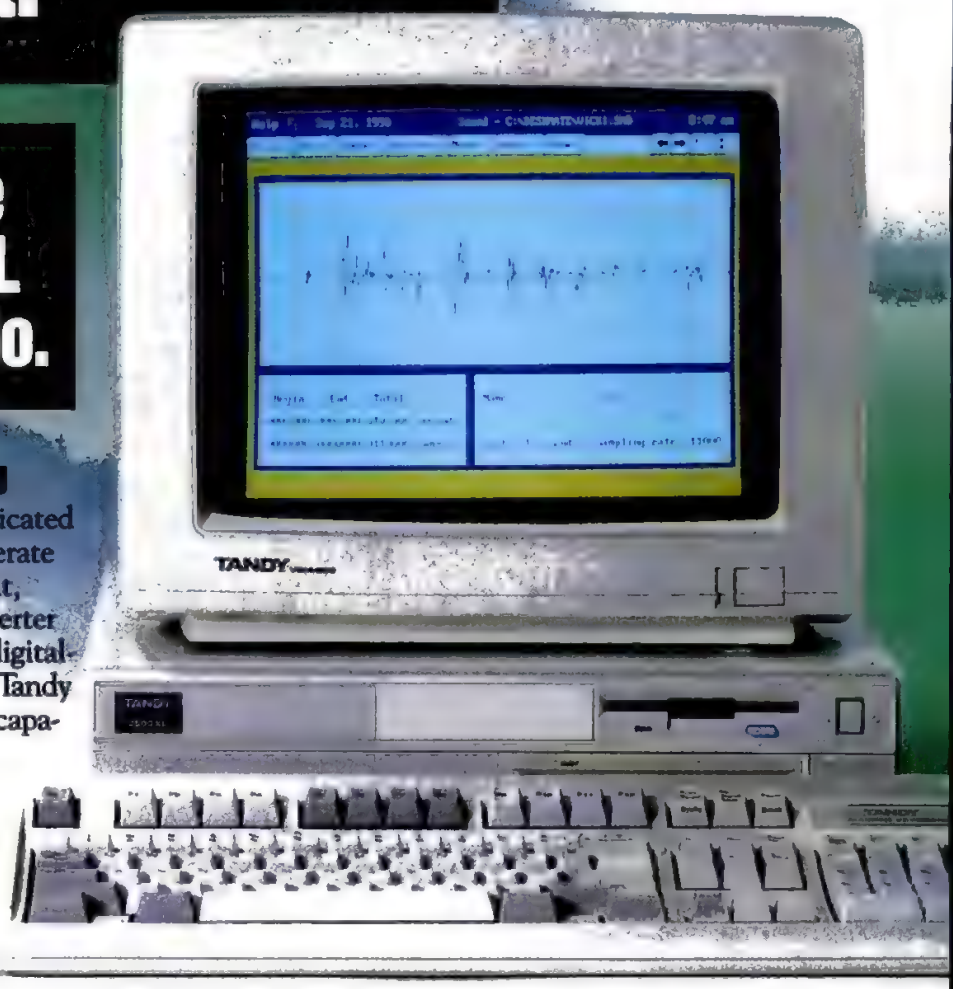

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CIRCLE 289 ON READER SERVICE CARD

by
Jeff Prosise

Tutor

THE INNER LIFE OF A TSR

As a user, you've encountered TSRs countless times. With the flick of a key, you could pop up a calculator or notepad or start a keyboard macro, even if you were in the middle of another application program.

But the simple elegance of TSRs almost always belies their inherent complexity. Because DOS was intended to run one program at a time—and one program only—TSRs are subject to restrictions that normal programs are not. And because these restrictions weren't documented in the DOS *Technical Reference* or anywhere else until recently, the inner workings of TSRs remain one of the greatest mysteries of MS-DOS to this day. Intrigued? Read on: my feathered friend Hawkeye and I will explore RAM-resident programs and take a look at a simple keyboard TSR to see what makes it tick.

- **THE INNER LIFE OF A TSR:** If you've wondered about the inner workings of RAM-resident programs, here's an in-depth look at what makes them tick.
- **USING A LASERJET WITH OS/2:** Installing a PM printer driver and configuring a system to use it—a three-step process.

As a student of Computer Science who is learning how to write programs for MS-DOS, I have yet to find a reference that provides a thorough explanation of how TSRs work. Would you please shed some light on this subject?

Garry Adkins
West Lafayette, Indiana

The best way to begin explaining how TSRs work is to look at the code for one. Figure 1 shows the assembly language listing for CLICK.COM, a simple TSR that watches the keyboard and clicks the PC's speaker each time a key is pressed.

Like all TSRs, CLICK.COM is divided into two parts. The first half contains the interrupt-processing code that hangs around after the call to terminate and stay resident is issued. The second sticks around just long enough to perform the necessary initializations, then goes away.

The initialization code, which receives control when the program is started, is contained in the procedure labeled INIT. INIT calls on DOS function 35h to retrieve the contents of interrupt vector 09h. Why 09h? Because when a key is pressed or released on the PC, the keyboard generates a hardware interrupt mapped to interrupt 09h by the interrupt controller, which signals the CPU that a key has been struck.

CLICK.ASM — **COMPLETE LISTING**

```
;*****************************************************************
; CLICK.COM clicks the PC's speaker each time a key is pressed.
; Assemble and link with:
;
;          MASM CLICK;
;          LINK CLICK;
;          EXE2BIN CLICK CLICK.EXE
;
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;*****************************************************************

code      segment   para public 'code'
          assume    cs:code
          org       100h

begin:    jmp       init                    ;Jump to initialization code

intvec    dd        ?                       ;Old interrupt 09H vector

;-----------------------------------------------------------------
; KBINT intercepts interrupt 09H and calls CLICK when a key is pressed.
;-----------------------------------------------------------------
kbint     proc      far
          pushf                             ;Save flags
          push                              ;Save AX
          in        al,60h                  ;Read scan code
          test      al,80h                  ;Check for break code
          jnz       exit                    ;Exit on break
          call      click                   ;Click on make code
exit:     pop       ax                      ;Restore AX
          popf                              ;Restore flags
          jmp       intvec                  ;Jump to BIOS handler
kbint     endp

;-----------------------------------------------------------------
; CLICK programs the speaker to produce a short click.
;-----------------------------------------------------------------
click     proc      near
          sti                               ;Interrupts on
          mov       al,0B6h                 ;Program timer 2 to generate
          out       43h,al                  ;  pulses
          jmp       short $+2
          mov       al,0                    ;Send low byte of the 16-bit
          out       42h,al                  ;  value that will determine
          jmp       short $+2               ;  the pulse frequency
          mov       al,6                    ;Then send the high byte
          out       42h,al
          jmp       short $+2
          in        al,61h                  ;Speaker on
          jmp       short $+2
          or        al,3
          out       61h,al
          push      cx                      ;Save CX
          mov       cx,1000h                ;Timing delay
here:     loop      here
          pop       cx                      ;Restore CX
          in        al,61h                  ;Speaker off
          jmp       short $+2
          and       al,0FCh
          out       61h,al
          ret                               ;Return to caller
click     endp

;*****************************************************************
; End of resident code -- start of initialization code.  Everything
; from here on is discarded when the program becomes memory-resident.
;*****************************************************************

init      proc      near
          assume    cs:code,ds:code
          mov       ax,3509h                ;Get the current interrupt
          int       21h                     ;  09H vector and store it
          mov       word ptr intvec,bx
          mov       word ptr intvec[2],es
          mov       ax,2509h                ;Point interrupt 09H to
          mov       dx,offset kbint         ;  the KBINT routine
          int       21h
          mov       dx,offset init          ;Use interrupt 27H to
          int       27h                     ;  terminate and stay
init      endp                              ;  resident

code      ends
          end       begin
```

Figure 1: Here is the assembly language listing for CLICK.COM, a small TSR that clicks the PC's speaker each time a key is pressed.

Under normal circumstances, execution goes to an interrupt handler in the ROM BIOS that reads a scan code from the keyboard. But CLICK.COM intercepts keyboard interrupts and examines the scan codes itself before the BIOS gets them. The original interrupt vector (the address of the BIOS routine that processes keyboard interrupts) is saved so that CLICK .COM knows what address to pass the interrupts on to once it's finished.

Once the interrupt vector is obtained and stored away in the variable called INTVEC, DOS function 25h is invoked to write a new value to the slot in the CPU's interrupt vector table that corresponds to interrupt 09h. The value written there is the segment:offset address of the routine named KBINT. Once this operation is completed, subsequent keyboard action transfers control to KBINT rather than to the BIOS interrupt handler.

The final action taken during the initialization phase of operation is a call to interrupt 27h, one of the two mechanisms DOS provides for programs to terminate and remain resident in memory. The address of the first byte in memory that will not be RAM-resident is passed in DS:DX. In this case, the address passed is that of INIT, so two of the three routines that are a part of CLICK.COM—KBINT and CLICK—will stick around after the program terminates, while INIT itself will be lost. Why discard INIT? Because after initialization is complete, INIT is no longer needed. Keeping it in memory would rob other programs of a few extra bytes.

After the call to interrupt 27h, CLICK .COM is resident in memory and hooked into the stream of data coming from the keyboard by virtue of the patch made to the interrupt vector table. When a key is pressed or released, the procedure KBINT suddenly finds itself coming to life. Its mission: read a scan code from the keyboard and, if it corresponds to the press (not the release) of a key, produce an audible clicking sound.

The key to determining whether a key was pressed or released lies in bit 7 of the scan code KBINT reads into AL. Bit 7 is set to 0 if a key was pressed, 1 if a key was just released. KBINT uses a simple TEST AL,80h instruction to clear the CPU's Z flag if the high bit of the scan code is set. When a key is pressed, KBINT calls the subroutine CLICK to click the speaker. Otherwise, it branches around the call. Its work finished until another key is pressed or released, KBINT executes a far jump to the address of the original interrupt 09h handler it displaced (whose address is stored in INTVEC) to allow the BIOS to process the keystroke. The BIOS is blissfully unaware that a TSR intercepted the keystroke on its way to the CPU.

Note that KBINT executes a PUSHF instruction followed by PUSH AX to save the CPU's flags and AX registers when it first assumes control, then pops them back off the stack before deferring to the BIOS.

> Executing an interrupt 21h from inside a TSR invites disaster unless some special precautions are taken.

The name of the game in TSR programming is to leave everything just as you found it. That means saving any register values modified (the stack is a convenient place) and restoring them on exit.

CLICK uses a rudimentary method of timing the duration of a click: it loads CX with the value 1000h and loops until CX counts down to 0. On the 20-MHz 386 machine on which CLICK.COM was written, 1000h produces a pleasing "tick" sound that resembles the click of a key; on slower machines, it may sound more like a short beep. If CLICK.COM sounds a little odd on your PC, experiment with different delay values by replacing the word at offset 0136h in the .COM file with something smaller than the default 1000h. Remember that in a word value stored in memory, the low byte comes first. In DEBUG, the sequence

```
DEBUG CLICK.COM
E 0136 00 04
W
/Q
```

will change the delay value from 1000h to 0400h.

THE PROBLEM WITH DOS

In its simplest form, that's all there is to it. Most TSRs work similarly to CLICK .COM: they hook into one or more of the PC's hardware interrupts and sit quietly in the background until an interrupt is triggered. Take CLICK.COM and add a few routines to save and restore regions of video memory and pop up windows on the screen and you've got a full-fledged TSR not unlike many of the ones published in *PC Magazine*'s Utilities column.

Well, almost. One characteristic of CLICK.COM is that it doesn't execute a single call to interrupt 21h from the resident part of its code. Interrupt 21h is the gateway to the myriad programming services offered by DOS itself. As long as a TSR doesn't need DOS for anything, its code remains relatively straightforward.

It's generally free to call on BIOS functions and to read and write to I/O ports as long as doing so doesn't upset some other part of the system. But operating system functions are a different matter. Executing an interrupt 21h from inside a TSR invites disaster unless some special—and rather complicated—precautions are taken. The reason for this is rooted deep within the workings of the MS-DOS kernel and summed up with the statement that DOS is a nonreentrant operating system.

A reentrancy occurs if a TSR executes an interrupt 21h after interrupting another call to interrupt 21h. Remember that hardware interrupts are usually triggered without regard to what's going on in the rest of the system—when a key is pressed or released, for instance. You have no assurance, when you press a key to pop up a TSR, that you haven't interrupted DOS in the middle of processing an interrupt 21h call made by another program. The problem is that DOS, single-tasking operating system that it is, assumes that calls will never be nested and thus that reentrancies will never occur. As a result, it does some things, when it answers calls to interrupt 21h, that will frequently crash the system when reentrancies do occur.

The primary cause of the problem is that rather than using the caller's stack when it fields an interrupt 21h, DOS switches to its own internal stack—one of three internal stacks, to be exact. DOS uses a stack known as the I/O stack to handle functions 01h through 0Ch; a separate stack, called the *disk stack*, to handle most higher-numbered functions; and a third stack, called the *auxiliary stack*, during processing of critical errors. The problem:

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if a second interrupt 21h is executed while one is already in process, the values the first one placed on the stack are overwritten by the second.

The solution may seem simple at first: avoid interrupt 21h when writing a TSR. But that's easier said than done. A TSR that reads and writes disk files almost has to use interrupt 21h, because the BIOS offers only sector-level disk services. There are dozens of other services DOS provides that the BIOS does not. Restricting a program from using DOS services severely limits the functionality it can provide.

The better solution is to take advantage of the built-in facilities that DOS provides for avoiding reentrancy conflicts. The first and foremost of these is the *InDOS flag*, a 1-byte flag whose address is returned in ES:BX when you execute an interrupt 21h with the value 34h in register AH. InDOS is incremented each time an interrupt 21h call is received and decremented when the call is completed. By checking InDOS, a TSR can tell if it's safe to make a call to interrupt 21h: if InDOS is zero, it's safe; if it's nonzero, then it's not. Restricting calls to DOS functions to only those times when InDOS is clear ensures for the most part that no reentrancies will occur.

But InDOS by itself isn't quite enough. When a critical error occurs, DOS clears the InDOS flag and enters an unstable mode, in which only a small subset of DOS functions can safely be called upon. Attempting to invoke DOS services numbered 0Dh and higher in this state will crash the system. Basing its decision on InDOS alone may fool the TSR into thinking that the system is stable when it's really not. The solution: once a TSR checks InDOS and determines that the coast is clear, it must also check another 1-byte flag, known as the *Critical Error flag*. Only when both flags are set to zero is a TSR free to use DOS services without restriction.

The only problem with the Critical Error flag is locating it. There's no simple service that returns its address like function 34h does for InDOS. In DOS 3.1 and later, there's an easy workaround: the Critical Error flag is always located in the byte immediately preceding InDOS, so a call to function 34h in effect locates both flags. But in earlier versions, finding the Critical Error flag requires a program to search the DOS segment (the segment whose address is returned in ES by function 34h) for a code sequence that looks like the one shown in Figure 2. Once the code (part of the DOS kernel itself) is located, the address of the Critical Error flag is the offset of the byte referenced in the CMP instruction—the word located 3 bytes beyond the SS override.

Another reason that the InDOS flag alone isn't enough is that sometimes InDOS remains set for extended periods of time. When you're at the DOS prompt, for example, InDOS is nonzero the whole time, because COMMAND.COM calls DOS function 0Ah to read keyboard input. And function 0Ah, like other interrupt 21h functions, increments InDOS. If you stick strictly to the times when InDOS is zero, your TSR won't work, as long as the user is on the command line.

> There are dozens of services DOS provides that the BIOS does not.

The answer is interrupt 28h, also known as the *DOS Idle interrupt*. As function 0Ah loops waiting for keycodes to appear in the keyboard buffer, it executes interrupt 28h over and over. A TSR can hook into interrupt 28h and safely call on DOS services numbered 0Dh and higher inside the handler even if the InDOS flag is set. The reason you're restricted to functions 0Dh and higher is that while function 0Ah executes, DOS is switched to the I/O stack. Calling another function that uses the I/O stack—any function numbered 01h through 0Ch—will result in a reentrancy. The good news is that this isn't a severe constraint. Functions 01h through 0Ch all deal with character input and output and are rarely useful for anything but the most primitive I/O operations.

Even with all these signals to check, there are still times when a TSR can't get permission to call a DOS function. Have you ever tried to pop up *SideKick* only to have it chirp at you? That's *SideKick*'s signal that InDOS is set and that it's looking for DOS Idle interrupts, but none are being generated. Rather than risk crashing the system, *SideKick* opts simply to not pop up until InDOS comes clear or an interrupt 28h is trapped.

OTHER CONSIDERATIONS

There. We've safely navigated the reentrancy mine field. If a program verifies that it's okay to invoke a DOS function by checking InDOS and the Critical Error flag first (or invoking the function from inside an interrupt 28h handler), it's safe.

But there's more to life as a TSR than simply avoiding nested DOS calls. A cardinal rule of TSR programming is that a TSR has to keep from disturbing other active processes or writing data to regions of memory it doesn't own. Functions 1Ah, 2Fh, 59h, and 5Dh help it do this. If a TSR uses DOS's Find First and Find Next functions (functions 11h and 12h), it must first point DOS to an internal Disk Transfer Area (DTA) with function 1Ah. Otherwise, it might inadvertently destroy data in an application program's DTA. It must also save and restore the entry-level DTA address with functions 2Fh and 1Ah. Similarly, DOS 3.0 and later make extended error information available through function 59h when an error occurs as a result of a DOS function call. Thus, a TSR running under DOS 3.*x* should use function 59h to retrieve the current extended error information on entry and function 5Dh to restore it on exit.

Finally, two functions, 50h and 51h, relate to which process is the active process in memory. DOS identifies programs by the addresses of their Program Segment Prefixes, or PSPs—256-byte headers used to store process-related information. When a TSR that plans to use DOS file I/O

LOCATING THE CRITICAL ERROR FLAG — **COMPLETE LISTING**

```
36: F6 06 XX XX 00        CMP  BYTE PTR SS:[CEFlag],0
75  XX                    JNE  JmpDest
CD  28                    INT  28H
```

Figure 2: To find the address of DOS's Critical Error flag in DOS 3.0 and earlier, a program must search the segment where InDOS is located for the code sequence shown above. The address of the Critical Error flag is the offset of the byte referenced in the CMP instruction.

services first assumes control, it should call function 50h with the segment address of its own PSP in BX. Why? Because DOS stores information about open files in the active PSP. If a TSR opens a file while another process is active, the information is written to the latter process's PSP. This can result in unpredictable behavior—especially if the other process already has the maximum number of files open that DOS will allow.

The active PSP comes into play at other times as well. When a process calls function 48h to allocate a block of memory, for example, the block is tagged with the address of the active PSP. If that address belongs to another process, the memory the TSR allocated will be freed when the other process terminates.

Needless to say, after a TSR activates its own PSP, it should restore the original PSP before it exits. One glitch you should be aware of results from a peculiarity in versions of DOS prior to 3.0; calling function 50h or 51h from inside an interrupt 28h handler will crash the system if the Critical Error flag isn't set. The reason: DOS 2.*x* uses the I/O stack for calls to functions 50h and 51h, the same stack used by DOS functions that trigger interrupt 28h. By setting the Critical Error flag prior to invoking these functions (and resetting it afterward), a TSR can avert a stack conflict by forcing DOS to switch to the auxiliary stack rather than the I/O stack.

Another point to consider is that a TSR that uses the stack in any capacity should switch to an internal stack, just in case the caller's stack is almost full. Furthermore, the internal stack should be large enough to handle several nested function calls to the BIOS, in case the TSR is interrupted by another TSR that doesn't switch to an internal stack.

A final consideration to keep in mind when writing TSRs is that there are certain operations that simply cannot be interrupted. If the BIOS is currently processing an interrupt 13h call, a TSR shouldn't touch the disk. Most TSRs that utilize disk services intercept interrupt 13h to keep track of calls to it and simply refuse to pop up while a call is in progress. The bottom line is that a well-behaved TSR must take whatever steps are necessary to make sure it doesn't disturb other parts of the system. That's one reason protected mode is so attractive: there, processes are physically isolated from one another in memory, so it doesn't take Herculean programming efforts to write programs that will run safely alongside other programs.

If you want more information, the most comprehensive reference on TSR programming is Article 11 of the *MS-DOS Encyclopedia* (Microsoft Press, 1988). There you'll find a thorough explanation of all the issues that affect TSRs, in addition to real-world programming examples.

> A well-behaved TSR must take steps to make sure it doesn't disturb the system.

USING A LASERJET WITH OS/2

As the departmental manager for a group of OS/2 users, I'm thrilled that IBM has finally released a printer driver for the LaserJet in its most recent upgrade to OS/2 1.2 Standard Edition. But when I installed the LaserJet II driver on one PC and tried to print a file, I got the error message "Can't load Generic library. Please put GENERIC.DLL in your LIBPATH directory." What's happening? Did I install the driver incorrectly?

William Gilroy
Waco, Texas

You probably installed it correctly. What the documentation doesn't make clear is that you also need to copy the file GENERIC.DLL—the dynamic link library the LaserJet driver uses to communicate with PCL printers—from Device Driver Diskette 1 to one of the directories specified in a LIBPATH statement.

Installing a PM printer driver and configuring a system to use it is a three-step process. First, you install the driver itself through OS/2's Control Panel and copy the file GENERIC.DLL (PCL printers only) to your hard disk drive's \OS2\DLL directory. Second, you add the new printer to the Print Manager's list of installed printers. Finally, you designate the new printer as the system's default printer.

To add the LaserJet driver, bring up the OS/2 Control Panel and pull down the Installation menu. Select "Add printer driver." Then insert the disk labeled Device Driver Diskette 2 into drive A: and press Enter. After a momentary delay, a list of printer drivers will appear in a dialog box. Select LASERJET.LaserJet II from the list and let OS/2 copy it to the default C:\OS2\DLL directory. When you're finished, open a CMD.EXE window and copy GENERIC.DLL from Device Driver Diskette 1 to C:\OS2\DLL.

Next you need to add the new printer to the Print Manager's list of printers. To do so, open the Print Manager window, pull down the menu labeled Setup, select Printers, and press Add. In the ensuing Add Printer window, enter a name for the new printer, a description, the port it's attached to, and the name of the printer driver that will be associated with it. Finish by pressing the Add button at the bottom of the window.

If you want to redefine the printer's default operating parameters, press the Change button to get to the Change Printer window and press Printer Properties to get to Print Manager's printer configuration screen. Here you can specify how your LaserJet II is set up—what font cartridges are installed, whether it should default to portrait or landscape mode, what graphics resolution to use, and so on. When you're done, press OK to register the changes, Change to get back to the Change Printer window, and OK once more to get back to Print Manager.

With that, you're almost done. All that remains is to establish the LaserJet as the system's default printer. From Print Manager, pull down the Setup menu, select Application defaults, and highlight the name of the newly installed printer. Press Set to finish the job. When you're done, go back to the command prompt and print a short text file. If the installation worked, the printout should come rolling out of your printer after a short pause.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your questions answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the "By Modem" sidebar in the Utilities column). We're sorry, but we're unable to answer questions individually. ■

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FasTalk V.32/42 has the other features you expect for personal computer applications. Auto dialing is accomplished with the industry-standard Hayes command set. The modem will communicate at 9600, 4800, 2400, 1200, or 0–300 bps over dial-up lines. Auto answer, integral diagnostics and audible call progress detection are standard features.

For single-modem compliance with both V.32 and V.42, move up to FasTalk. You can do it at a surprisingly low cost.

For details, contact UDS, 5000 Bradford Dr., Huntsville, AL 35805-1993. Telephone 205/430-8000; FAX 205/430-8926.

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by
Frank J. Derfler, Jr.

Connectivity

LINKING LANs

I need to give people working on small LANs in our Chicago and Boston branch offices access to files on our corporate LAN in New York. How do I do it?

Jack Kendell
New York, New York

Lately, letters about how to link LANs in distant cities seem to outnumber those with questions like, "How do I connect three PCs in my law office?" There are two clear-cut LAN-linking alternatives. If you need to link LANs in order to exchange electronic mail, pass print jobs, and swap files, then you'll want to establish a remote-access PC on each network. If, on the other hand, you want invisible connections with full functionality between LANs, then you should use bridges or routers. You'll need a hefty budget to support them, though.

A remote-access PC, equipped with any remote-control program and a modem, can receive calls from PC users on the other LANs. The callers remotely operate the PC on the distant LAN, use resources such as printers and e-mail programs on that LAN, and exchange files between LANs. This type of LAN-to-LAN connection doesn't transfer all of the overhead data (such as DOS requests and the layers of network protocols carrying those requests) over the long-distance communications link between LANs. Instead, screen images and keystrokes make up the typical traffic over the communications line. When you do transfer files between the linked networks, the software routines in today's remote-control programs do the job as efficiently as possible.

While using a remote-access PC on a LAN is economical and effective, it isn't invisible or convenient. Someone must dial the telephone number of the PC on the distant LAN, log in, and remotely control the activities. The caller must know about the file structure of the remote server and the specific resources on the remote network. It's more convenient to see the servers on the distant LANs as DOS drive letters on each networked PC. And that's the capability you gain with a LAN bridge.

- **LINKING LANs:** Here are two good ways to connect distant LANs.
- **LAN FAX GATEWAYS:** A software alternative to the typical hardware-and-software solution.
- **FILE SECURITY:** How can patients' files be protected from unauthorized access?

If you prefer invisible links between LANs in distant places, take a look at Microcom's family of LAN bridges for Ethernet or Token-Ring systems. These bridges don't care what types of protocols you use on your networks. The complete turnkey packaging of these bridges makes them appealing to people who don't enjoy juggling IRQs and memory locations during communications server installations.

The Microcom MLB/5000 series of LAN bridges links two LANs together using 9.6-kilobit-per-second V.32 modems and Microcom's MNP V error detection and file compression protocols. This speed is great for file transfers, but it isn't good enough for remote access to database files. If you want to give several users simultaneous access to database files on distant LANs, you'll have to pay for 56- or 64-Kbps leased-line service. The cost for leased lines depends on a number of factors, including distance, the type of long-distance carrier you choose, and volume discounts, but it's typically in the range of thousands of dollars per month for these high-speed, long-distance services.

The Microcom bridges cost around $8,500, depending on the modems and network adapter cards you need. But for this price, you get a completely configured unit including a PC with a 12-MHz 80286 processor. You need only know how to plug the RJ-11 connector into the modem and the network cable into the adapter card. Of course, you need a bridge for each LAN you want to link.

If you need to link more than two bridges, then you'll want to consider using X.25 value-added networks like Tymnet, Telenet, and AT&T's Accunet instead of leased long-distance lines. Microcom markets its MLB/6500 series bridges for X.25 LAN-to-LAN connections.

So there are two basic ways to link LANs: the economical remote-access control technique that requires manual intervention, and the higher-cost, invisible LAN bridge alternative for full LAN services. Contact Microcom at (800) 822-8224 for more information.

LAN FAX GATEWAYS

In the April 10, 1990, issue of *PC Magazine*, you reviewed LAN fax gateways that allow users on a network to share a fax device. I've read about a fax gateway called *LanFax*, from Alcom, that seems to work differently from the products you reviewed. Can you explain the difference?

Ralph Wilkerson
New York, New York

Typically, when you establish a communications server on a network with the specific function of opening the network to a totally different communications system like SNA or fax, it's called a *gateway*. In common practice, a gateway is a hardware-and-software system that translates low-level protocols and even data alphabets between the LAN and the external system. Most LAN gateway products include the software that runs on each PC, the software for the communications server, and adapter hardware.

However, the situation gets complex in the electronic mail and fax arenas, because several companies sell products that are just a part of the communications server

system. Whether the gateway is the total communications server or just part of it is something experts argue about.

Alcom's *LanFax*, Version 2.2, is a different breed of LAN fax gateway product, because users never see it. *LanFax* is a unique piece of software that links Action Technology's Message Handling Service (MHS) software to one of several fax modems. *LanFax* works between MHS and the fax modem while other e-mail software you supply operates between MHS and your users. Optional software modules work with *LanFax* to send messages to Telex, Western Union's EasyLink, MCI Mail, and to perform binary file transfers.

Applications such as *Framework III*, *cc:Mail*, *DaVinci E-mail*, and *Indisy* send messages to MHS for delivery. MHS and *LanFax* run together in one networked PC that acts as the MHS and fax server for the network. *LanFax* takes messages with a fax destination from MHS and routes them to the modem. The software converts network e-mail messages—text and graphics—to a facsimile format. The fax server must be equipped with a compatible fax modem, such as the Intel Connection CoProcessor, GammaFax, GammaFax CP, or Brooktrout. *LanFax* works on a wide variety of network operating systems, including Novell's *NetWare*, 3Com's *3+Share*, and Banyan's *VINES*.

The *LanFax* software provides a fax connection simultaneously for up to ten workstations on a LAN, at a cost of $995. There is also a module, available for $1,495, that allows an unlimited number of users on your network. And you can purchase a package that includes an Intel Connection CoProcessor board if you don't already have a compatible fax board on your network, but in this case plan to spend another $695. (See our feature review this issue, "Speed, Price, Convenience: Fax Boards Deliver.")

LanFax automatically handles message transmission and reception, and you can tell it to defer sending messages until after prime-rate phone periods.

Alcom's *LanFax* runs in a PC with 640K RAM, at least a 10MB hard drive, a graphics program and an appropriate LAN interface card. The total system needs MHS, a compatible fax modem, and an MHS application in addition to *LanFax*. If you'd like to learn more about the *LanFax*, contact Alcom at (415) 493-3800.

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CIRCLE 483 ON READER SERVICE CARD

FILE SECURITY

Our small hospital maintains patient reports in *WordPerfect* 5.0 format on a Novell network. We need to devise a system that allows physicians access only to documents of patients with whom they have an association.

For example, Patient #1 has been seen by Doctors A, B, and C. All of these physicians should have access to Patient #1's reports. Patient #2 has been seen by Doctors A, C, and D. Patient #2's reports should be accessible only to these doctors.

Each report is named with the following format: <patient number>.<report type & number>. For instance, the filename 102277.P01 can be decoded as patient number 102277, report type Pathology, report number 1.

We use an ASCII file to describe patient-

physician relationships. Patients are identified by patient number, while physicians each have a three-digit physician number. So the file might contain an entry like this:

```
Patient   102277
Dr. 1      849
Dr. 2      105
Dr. 3      921
```

A physician should be able to retrieve the appropriate patient reports from a Novell workstation but be denied access to reports that don't concern his or her patients.

Can you provide any suggestions on how we should go about implementing such a system?

Michael Derhak
Springfield, Oregon

My first thought is that you can make each patient's number into a Novell "Group Belonged To," as the Syscon menu quaintly phrases it. Only users belonging to that group have access rights to that group's files. As a doctor acquires the need to access a patient's record, someone with a system administrator's rights for that group would add that doctor to the patient's group. Adding such authorization takes only a few seconds, but it is a manual task. And since I doubt that the physicians use *WordPerfect* to make their own entries into the records, perhaps you can tolerate a manual setup of this particular security feature.

Now, how about some better ideas from our readers? This is a real-world problem that some of you must have faced. Do you know of a product or perhaps a database programming technique that will automate access control? Remember, we pay for tips that we print!

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We'll pay $50 for any tips we print. Please submit your letter on a disk along with a printout. Then mail your contributions to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We're sorry, but we're unable to answer letters individually. ■

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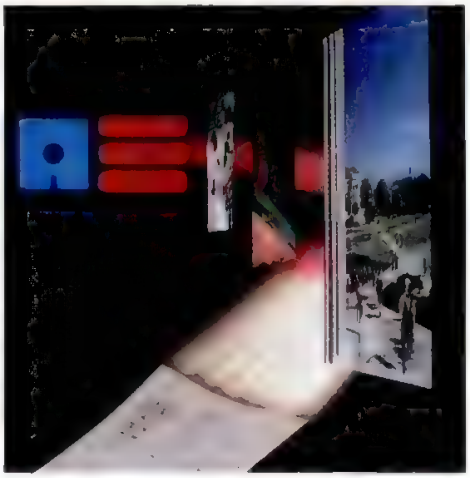

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CIRCLE 736 ON READER SERVICE CARD

Computers, FCC Class A, Class B, and You — or When is it better to get a B than an A?

You need to know the difference between computers that meet the FCC class B radio frequency emissions standards and those that meet only the Class A standards.

Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

What the ex driving

Ask any PC enthusiast and they'll tell you that the Microsoft® Mouse is one very hot number.

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For more information inside the 50 United States, call (800) 541-1261, Dept. K84. In Canada, call (416) 673-7638. Outside the U.S. and Canada, call (206) 882-8661. *© Copyright 1990 Microsoft Corporation. All rights reserved. Microsoft and the*

perts will be this year.

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What it means is you can race through even the most complicated software programs without hesitation.

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To get more information about the Mouse, or if you'd like to take a complete and thorough test drive, see your local Microsoft dealer.

One spin through your favorite program and you'll realize there's nothing else like it.

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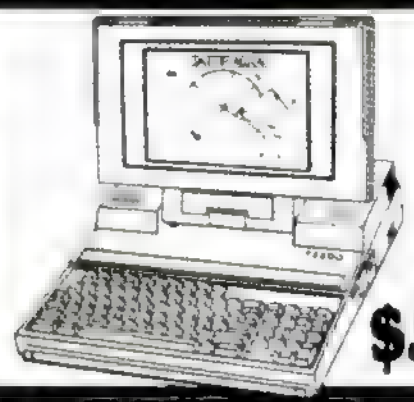

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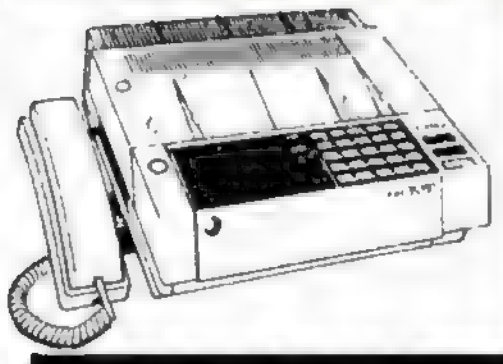

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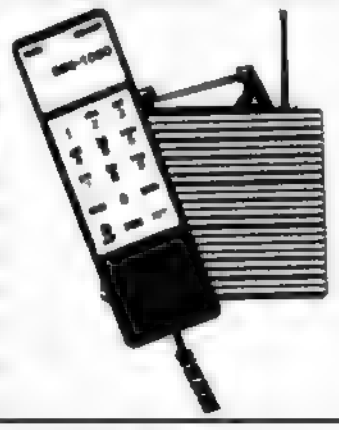

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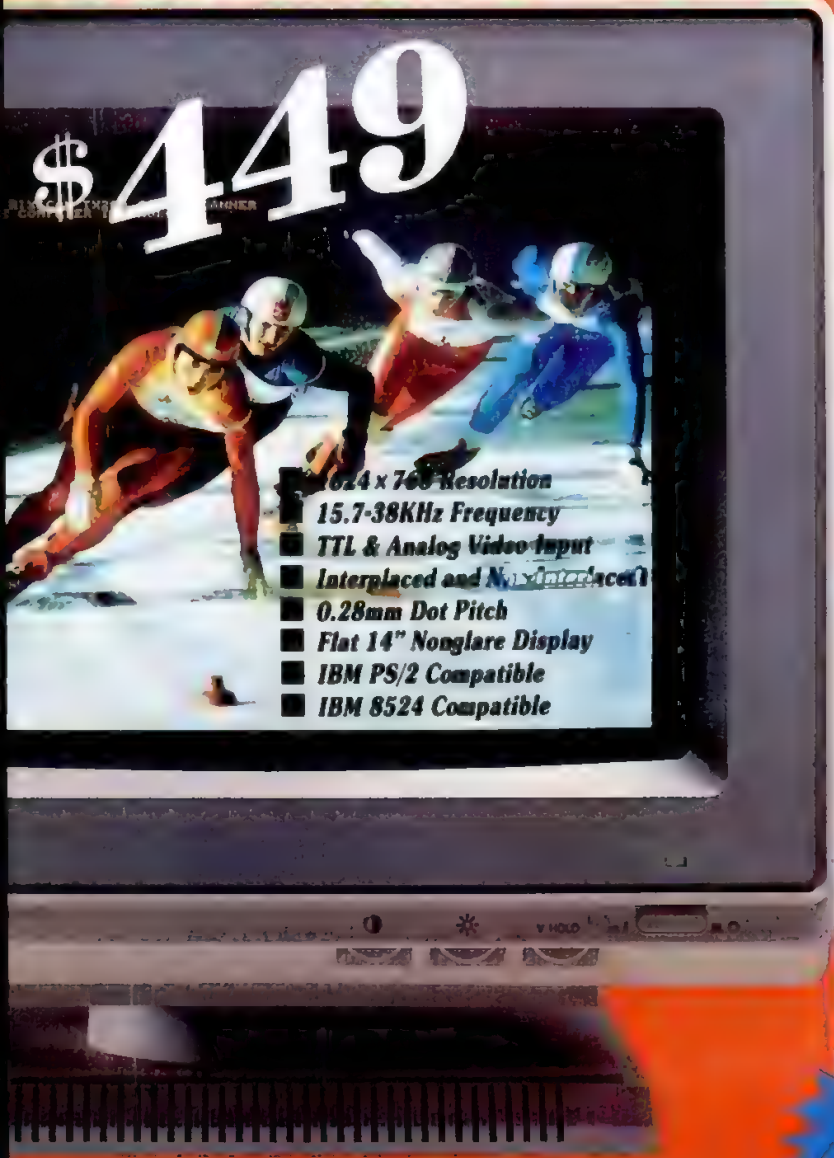
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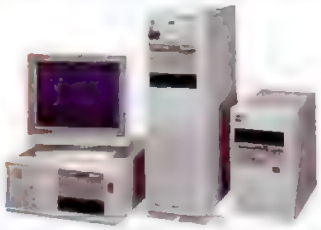

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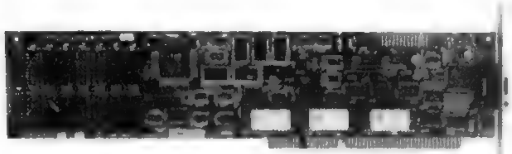

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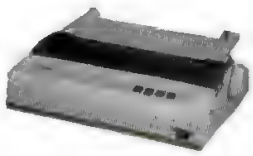

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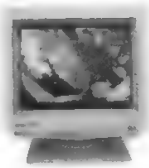

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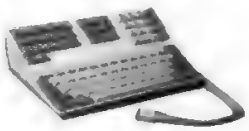

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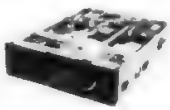

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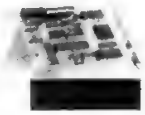

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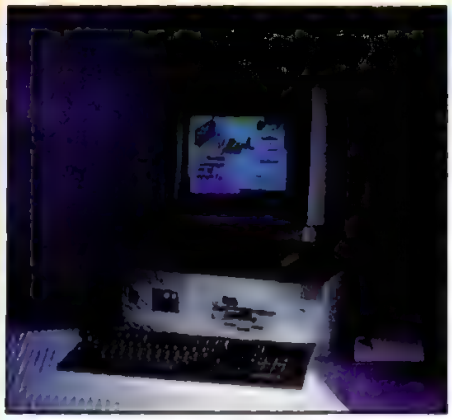

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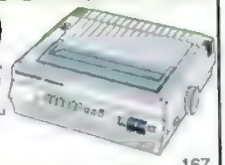

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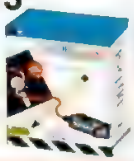

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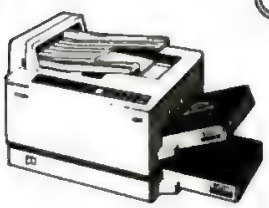

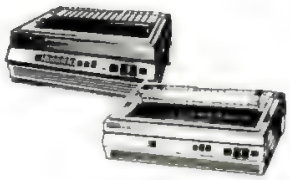

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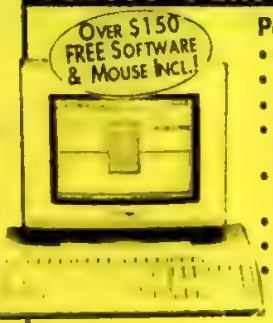

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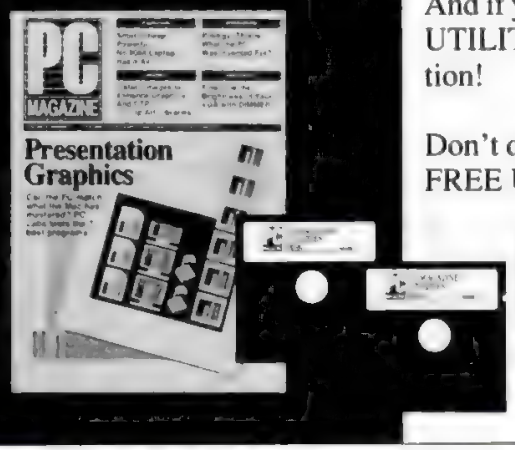

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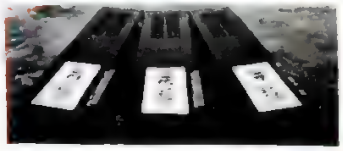

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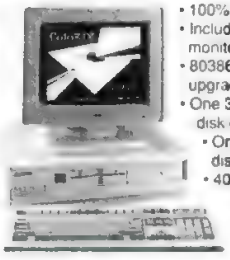

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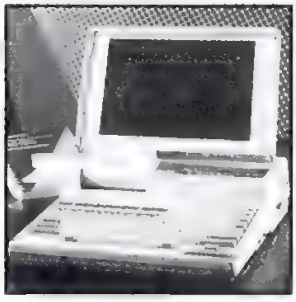

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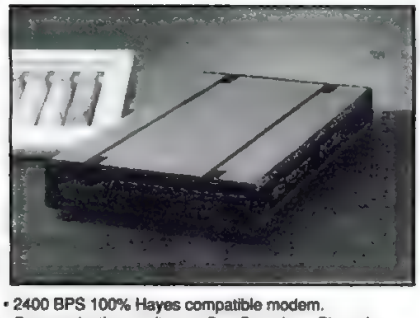

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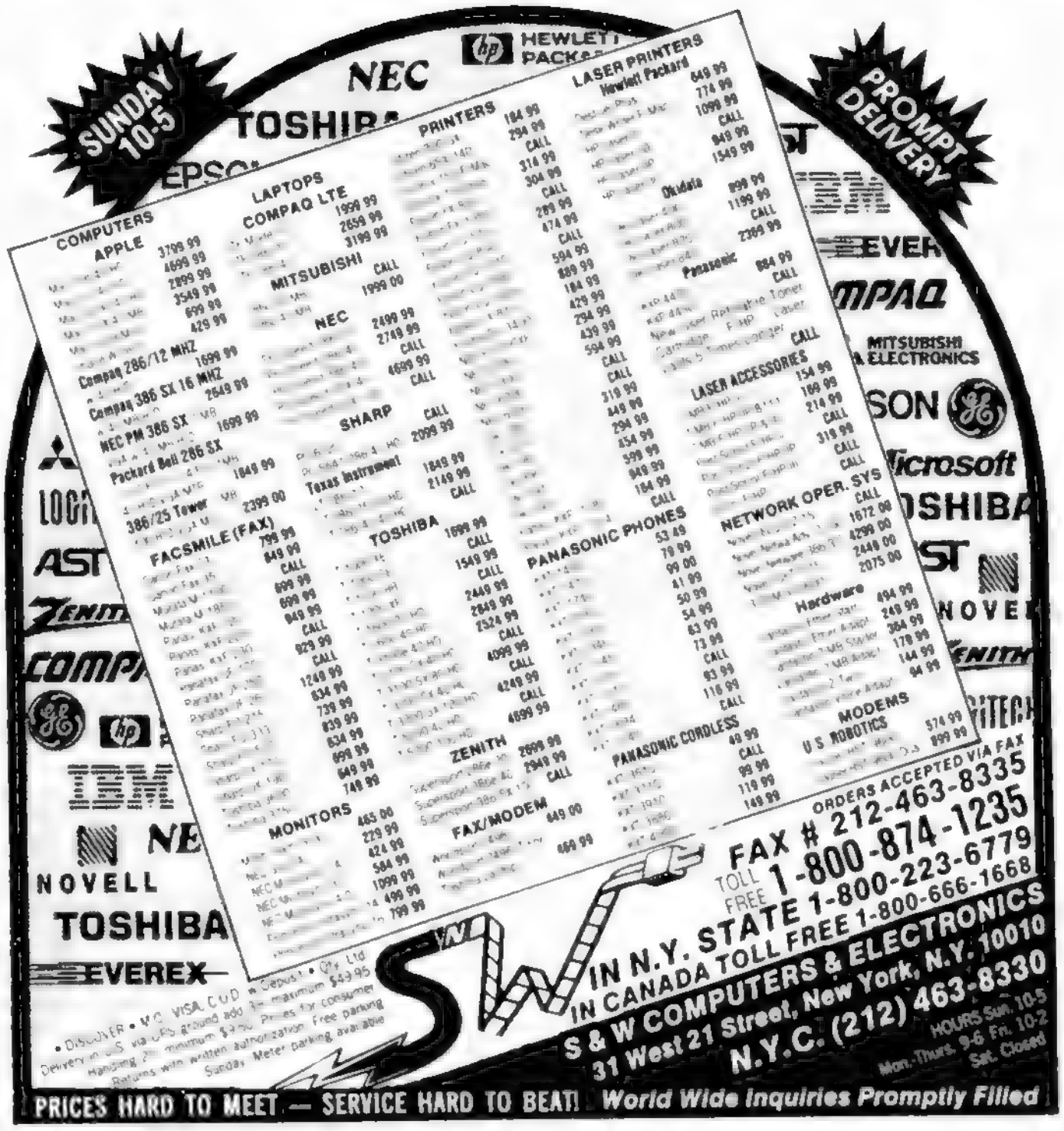

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Add-On-Boards 501
Cables 503
CD-ROM 503
Communications 503
Computer Systems 507
Disk Drives 512
Diskettes 513
Expansion Units 513
Input Devices 514
Peripherals 514
Power Supplies 514
Printers 514
Security 515
Tape Drive Subsystems 515

SOFTWARE

Accounting 517
Business 517
Business Project Management 517
Business Time Management 517
CAD/CAM 518
Communications 518
Construction 518
Data Base 518
Data Entry 518
Desktop Publishing 518
Dictionary 519
Diagnostic 519
Education 519
Engineering 519
Entertainment/ Games 519
Financial 520
Flowcharting 520

SOFTWARE

Foreign Languages 520
Graphics 521
Health 522
Inventory 522
Mailing Programs 522
Manufacturing 522
Medical 522
Music 522
Preventative Maintenance 523
Programmers Tools 523
Public Domain/ Shareware 524
Real Estate 524
Religion 524
Sales Marketing 525
Scientific 525
Security 525
Statistics 526
Surveys 526
Utilities 527
Windows 527
Word Processing 527

MISCELLANEOUS

Accessories 527
Add-On-Boards 528
Bar Coding 528
Books/Catalogues/ Publications/ 530
Data Conversion 530
Data Recovery Services 530
Disk Conversion 530
Diskette Copy Service 531
Insurance 531
Services 531
Supplies 532

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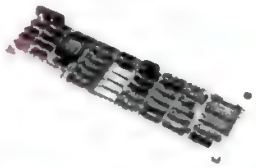

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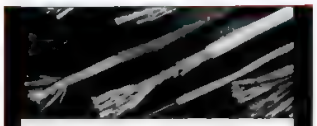

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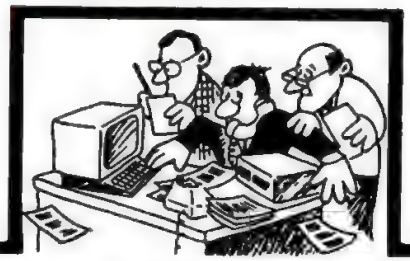

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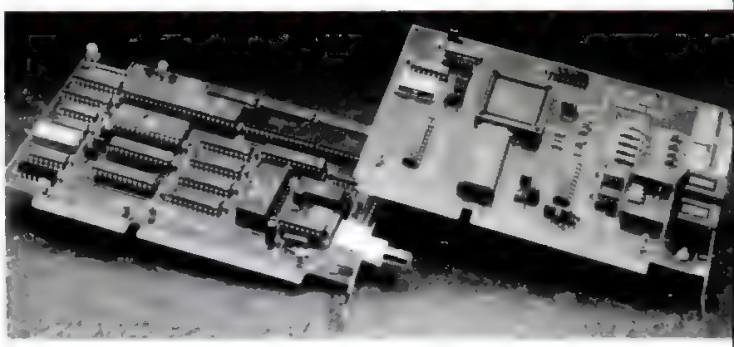

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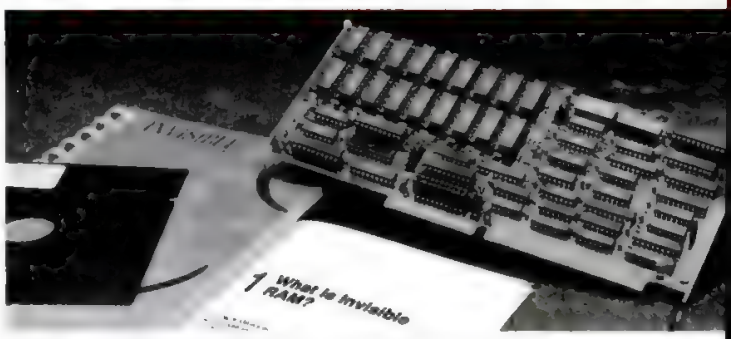

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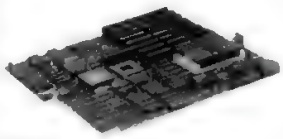

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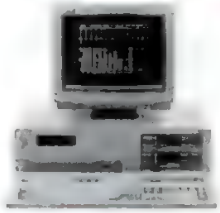

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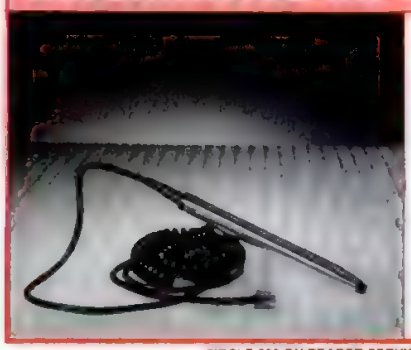

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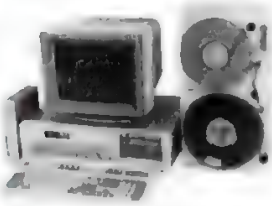

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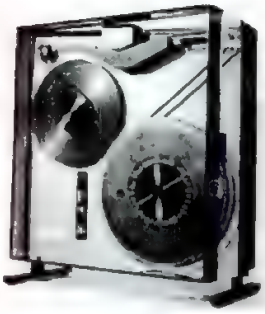

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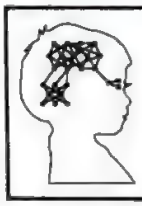

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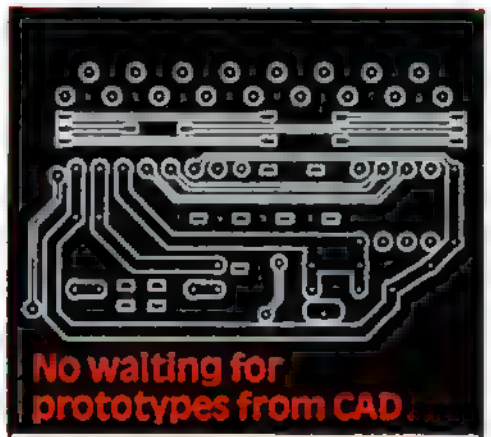

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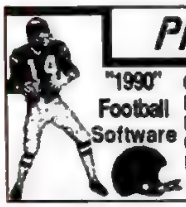

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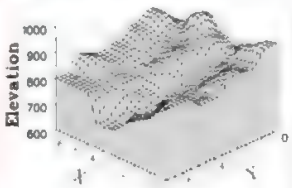

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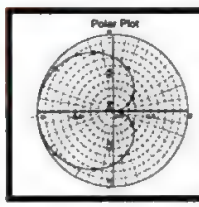

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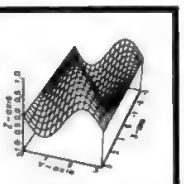

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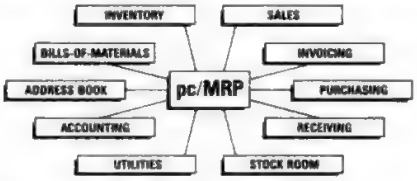

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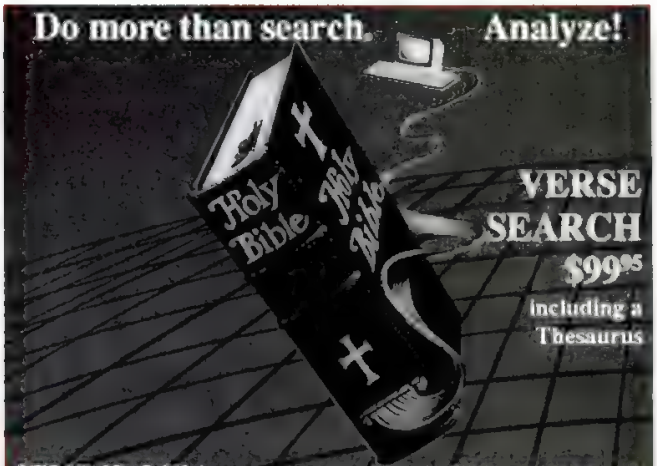

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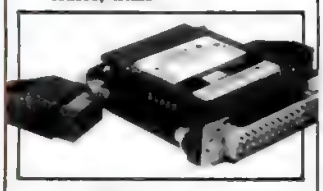

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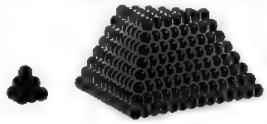

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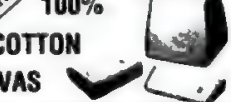

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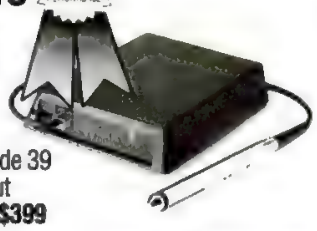

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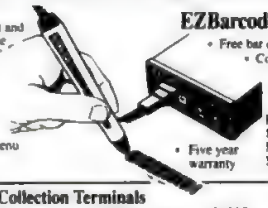

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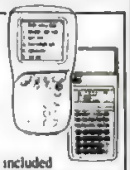

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638	SmartFax 48	American Data Technology Inc.	312
639	Fax-Mail 96	Brooktrout Technology Inc.	313
640	EZ-Fax48	Calculus Inc.	316
641	EZ-Fax96	Calculus Inc.	316
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643	DeskFax Professional	Choice Technology Group Ltd.	321
644	The Complete FAX	The Complete PC	324
655	The Complete FAX/Portable	The Complete PC Inc.	350
645	Lightfax 9624BH	Computer Friends Inc.	326
656	dds4000	Digital Data Systems	350
646	SkyFAX	ESCO Systems Inc.	326
657	Everex EF 12/48	Everex Systems Inc.	350
647	EverFax 24/96	Everex Systems Inc.	339
648	FaxPro I	The Fax Group	340
649	FAX96	Fremont Communications Co.	340
650	GammaFax NA	GammaLink	346
651	Hayes JT Fax 4800B	Hayes Microcomputer Products Inc.	349
658	Hayes JT Fax 4800 Portable	Hayes Microcomputer Products Inc.	350
661	HiJaak	Inset Systems Inc.	343
652	Connection CoProcessor	Intel PCEO	350
653	MaxFax 9624	Macronix Inc.	352
654	ProModem 2400BFAX	Prometheus Products Inc.	352
659	WorldPort 2496 Fax/Data Modem	Touchbase Systems Inc.	350

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READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
407	Personal Lawyer (General Edition)	BLOC Publishing	537
407	Personal Lawyer/Lifestyles	BLOC Publishing	537
410	Shufflepuck Cafe	Broderbund	540
409	Loom	Lucasfilm Games	540
405	Hyatt Legal Services Home Lawyer	Meca Ventures Inc.	537
408	WillMaker 4.0	Nolo Press	537
406	It's Legal	Parsons Technology	537

COMMUNICATIONS

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
434	The Visionary 2400XT	Visionary Electronics Inc.	48

COMPUTERS

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
416	ACMA 386SX	ACMA Computers Inc.	102
417	Amax 386SX Business System	Amax Engineering Corp.	104
418	BroadAx BSI 386SX	BroadAx Systems Inc.	109
419	CAF Master 386SX/16	CAF Technology Inc.	113
420	Ultra 386SX	Computer Market Place Inc.	115
421	Coté 386 Plus	Coté Computers of Arizona Inc.	117
422	C^2 Microsystems 386SX	C^2 Microsystems Inc.	138
423	Work Master 386SX	Dyna Micro Inc.	138
424	EXP 386SX	Express Micro Mart Inc.	139
425	Fortron NetSet 386SX	Fortron/Soource Corp.	142
426	Gateway 2000 80386SX	Gateway 2000 Inc.	149
427	HiQ386SX-16/20	HiQuality Systems Inc.	150
428	Micro Express ME 386SX	Micro Express	153
429	Mitsuba MIT-SXA	Mitsuba Corp.	154
542	Flash 386SX-16	National Micro Systems Inc.	154
543	Novas 386SX-16	Novacor Inc.	161
544	PC 386/SX Business System	Pan United Corp.	162
545	PCC 2260/16SX	PC Craft Inc.	167
546	PSG 80386SX/16	Precision Systems Group Inc.	167
547	Tenex 386SX HD VGA System	Tenex Computer Express	168
548	Treasure Chest TC 386SX	Treasure Chest	175
669	Personal System/1	IBM Corp.	33

CONNECTIVITY

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
396	AMR Video Graphics Network Adapter	Advanced Micro Research	383
439	Hook-Up FX96/24	Computer Peripherals Inc.	53
397	SunRiver Fiber Optic Station	SunRiver Corp.	390
398	VPT System 2000	Viewport Technology Inc.	394

GRAPHICS (HARDWARE AND SOFTWARE)

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
401	DoDOT	Halcyon Software	282
402	The Graphics Link Plus*	HSC Software	284
664	Desktop Computing AGA 1024	Desktop Computing Inc.	44
403	HiJaak	Inset Systems Inc.	297
668	Hercules Graphics Station Card	Hercules Computer Technology Inc.	44

HARDWARE

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
438	The PostScript Cartridge	Adobe Systems Inc.	53
609	Artec Mouse AM-21 Plus	Artec Inc.	224
432	Turbo C++ 1.0 Professional	Borland International	36
610	CalComp Wiz Mouse System	CalComp Inc.	226
611	Chicony Keyboard KB-5581	Chicony America Inc.	226
612	RollerMouse	CH Products Inc.	233
613	CMS Mini Mouse	CMS Enhancements Inc.	233
614	Fancy Mouse	Commax Inc.	234
614	Witty Ball	Commax Inc.	234
614	Witty Mouse (not reviewed)	Commax Inc.	234
665	JetPage PostScript Emulation Cartridge	Computer Peripherals Inc.	53
615	Dell Serial Mouse	Dell Computer Corp.	234
616	DMS-200 Mouse	DFI Inc.	235
616	DMS-200H Mouse	DFI Inc.	235
617	Focus FT-100 Tracker	Focus Electronic Corp.	235
618	Trackball Plus	Fulcrum Computer Products Co.	237
619	IBM Mouse	IBM Corp.	238
620	The MousePen	International Machine Control Systems	240
621	IMSI Mouse	International Microcomputer Software Inc.	242
622	Mouse-Trak	ITAC Systems Inc.	242
623	Kensington Expert Mouse	Kensington Microware Ltd.	242
624	Key Tronic Professional Series Mouse	Key Tronic Corp.	249
625	Kraft Trackball	Kraft Systems Inc.	251
626	Genius Mouse F303	KYE International Corp.	251
626	Genius Mouse GM-6X	KYE International Corp.	251
626	Genius Mouse GM-6000	KYE International Corp.	251
627	ProCorp Mouse	Liuski International	253
628	Decca Mouse	Logitech Inc.	254
628	Series 9 Mouse	Logitech Inc.	254
628	TrackMan Stationary Mouse	Logitech Inc.	254
629	Lynx Turbo Trackball	Lynx Computer Products Inc.	256
630	Marconi Marcus RB2-305	Marconi Circuit Technology Corp.	256
630	Marconi Marcus RB2-306	Marconi Circuit Technology Corp.	256
631	Microsoft Mouse	Microsoft Corp.	256
549	PC-Trac	MicroSpeed Inc.	258
549	FastTRAP	MicroSpeed Inc.	258
550	OmniMouse II	Mouse Systems Corp.	258
550	PC Mouse	Mouse Systems Corp.	258
550	PC Mouse III	Mouse Systems Corp.	258
550	PC Trackball	Mouse Systems Corp.	258
550	The White Mouse	Mouse Systems Corp	258
601	Manager Mouse Cordless	Numonics Corp.	263
602	TrackerMouse/TM1	Penny + Giles Controls Inc.	265
602	TrackerMouse/TM1 Plus 16	Penny + Giles Controls Inc.	265
602	TrackerMouse/TM1 Plus 32	Penny + Giles Controls Inc.	265
603	The Cordless Mouse	Practical Solutions Inc.	265
604	ProHance PowerMouse 100	ProHance Technologies Inc.	268
605	Samurai Mouse	Qualitas Trading Co.	272
606	SmarTEAM Mouse	SmarTEAM Inc.	274
607	MouseTrac	Suncom Technologies	276
607	SunMouse	Suncom Technologies	276
608	Tandy Serial Mouse	Tandy Corp.	277
608	Tandy 2-Button Mouse	Tandy Corp.	277

SOFTWARE

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
632	Lotus 1-2-3/G	Lotus Development Corp.	364
430	SoftType	ZSoft Corp.	46
431	VP to the Max	Aristocad, Inc.	49
433	Bridge 2.0	The Softbridge Group	49
435	Scrimage, Version 2.0	Synergy Corp.	48
436	Microsoft Powerpoint	Microsoft Corp.	43
437	Wingz	Informix Software Inc.	53
440	ReadRight Personal	OCR Systems Inc.	53
441	Access for Windows	Eicon Technology Corp.	54
442	Relay Gold For Windows	Microcom Software Division	54
443	ObjectScript	MATESYS Corp.	54
444	ObjectView	MATESYS Corp.	54
445	ShowCase	Rochester Software Connection	54
446	Spinnaker Plus	Spinnaker Software	54
447	Image-In	Image-In Inc.	59
448	ImagePrep	Computer Presentations	59
449	WordScan	Calera Recognition Systems	59
450	WordScan Plus	Calera Recognition Systems	59
663	Harvard Graphics 2.3	SPC Software Publishing	33
666	Prompt, Version 2.0	Access Softek	38

UTILITIES

READER SERVICE NUMBER	PRODUCT	COMPANY	PAGE
413	DR-Chips	Alpha Group Operation	186
411	AMIDIAG, Version 3.14	American Megatrends Inc.	181
414	QAPlus, Version 4.21	DiagSoft Inc.	188
415	Service Diagnostics: The Kit	SuperSoft Inc.	200
412	Checkit, Version 2.1	Touchstone Software Corp.	182

PRODUCTIVITY

DEPARTMENT	PROGRAM NAME/DESCRIPTION	PAGE
Lab Notes	Exploring and organizing hard disks with Lotus's Magellan.	407
Utilities	Compile batch files for added speed with BAT2EXEC.	415
Environments	Taking Advantage of the 386: The 32-bit version of OS/2.	429
Power Programming	Application development using OS/2 2.0's memory management.	435
Windows	How to link data files with applications in WIN.INI.	441
Windows	Ease into Windows 3.0 using File Manager as the opening screen.	442
Databases	An explanation of Reflex and the difference between flat-file and multifile databases.	447
Spreadsheets	File-linking for Lotus users is made easier with Quattro Pro.	453
Spreadsheets	A macro that makes it easy to set the widths of several columns at once.	454
The Working Word	How to create moving light bar menus in WordPerfect 5.0.	461
The Working Word	How to bypass the 32-font limit in WordPerfect 5.1.	462
User-to-User	Make case-insensitive string comparisons in batch files	463
User-to-User	An easy way to switch between sets of CONFIG.SYS and AUTOEXEC.BAT files.	463
Tutor	An indepth look at the inner workings of RAM-resident programs.	467
Tutor	Three steps for installing a PM printer driver.	472
Connectivity	Two good ways to connect distant LANs.	475
Connectivity	The difference between LAN fax gateways and LanFax.	475
Connectivity	One way to protect files from unauthorized access.	476

ADVERTISERS PRODUCT INDEX

RS#	ADVERTISER	PRODUCT	PAGE#
ACCOUNTING SOFTWARE			
380	Bloc Publishing	Form Designer	70
342	Protec Microsystems, Inc.	Byte Link	433
736	American Fundware	Fund Accounting Software	477
375	Computer Associates	ACCPAC	286
194	Cougar MT Software	Accounting Software	277
CHIPS/PROCESSORS			
354	Data Pro Accounting Software	Accounting Software	443
ACCOUNTING SOFTWARE			
354	Data Pro Accounting Software	Accounting Software	443
*	IBM Corp	Platinum	83
263	Macola Inc.	Accounting Software	18-19
DATABASE MANAGERS			
287	Borland International	Paradox	446
178	Clarion Software	Professional Developer	298
315	Concentric Data Systems	R&R Relational Report Writer	285
112	Fox Software Inc.	Database Managers	68
291	Map Info	MapInfo Database	412
539	Microrim	Microrim R-B Database Software	348
*	Oracle	Database Software	88
FINANCIAL PLANNING SOFTWARE			
*	Intuit Software	Quicken	40-41
INFORMATION MANAGERS			
117	Chronologic Corp	Instant Recall	155
315	Concentric Data Systems	R&R Relational Report Writer	285
LANGUAGES			
201	Lahey Computer Systems	Language	206
OPERATING SYSTEMS/ENVIRONMENTS			
382	Data General	Aviion Family/Portable Netware	392-393
243	DSC Communications	DSC NEXOS	423
*	IBM Corp	OS/2	395
393	Software Link, Inc.	PC-MOS	74
PROGRAM DEVELOPERS/GENERATORS			
382	Data General	Aviion Family/Portable Netware	392-293
PROJECT MANAGEMENT			
*	Computer Associates	Super Project	470
148	Primavera Systems	Project Management Software	58
*	Scitor Corporation	Project Scheduler 4	60
264	Symantec	Time Line 4 0	26
STATISTICAL SOFTWARE			
103	SPSS, Inc	Statistical Software	178
UTILITIES			
328	Buffalo Products	Printing Utility	305
749	Central Point Software	PC Tools Deluxe	66-67
315	Concentric Data Systems	R&R Relational Report Writer	285
382	Data General	Aviion Family/Portable Netware	392-393
236	Fifth Generation	Utility	203
224	Franklin Software	Language Master	82
162	Gibson Research	SpinRite II	428
313	Helix Software	Netroom	406
170	Multisoft Corporation	Super PC Kwik	456
140	PC Publishing	SpreadsheetSLotus Add-On Utility	369
340	Touchstone Software Corp.	Check It	28
WINDOWS SOFTWARE			
340	Touchstone Software Corp.	Check It	28
WORD PROCESSING SOFTWARE AIDS			
315	Concentric Data Systems	R&R Relational Report Writer	285
224	Franklin Software	Language Master	82
325	IQ Engineering	IQ Super Cartridge	105
*	Microsoft	Word For Windows	C2-4, p 1
241	Pacific Data Products, Inc.	Pacific Page I/P	302
*	Software Publishing	Word Processing Package	255
*	WordPerfect Corporation	Word Processing Software	94
518	XyQuest Inc.	Word Processing	62
CAD/CAM			
475	American Small Business Comp	CADD	71
506	Generic Software	CAD CAM Software	207
265	Intergraph Corporation	Microstation PC	413
154	Mathsoft Inc.	PC CAD V 2 5	455
195	National TeleVAR	DTP Workstation	424-425
SPREADSHEET/TEMPLATES			
119	Baler Software	Spreadsheet Computer	21
285	Borland International	Quattro Pro	452
323	Funk Software	PDQueue	80
323	Funk Software	Spreadsheet Utilities	80
325	IQ Engineering	IQ Super Cartridge	105
*	Lotus Development	123 HP	39
*	Lotus Development	123/G	78-79
140	PC Publishing	Spreadsheet/Lotus Add-On Utility	369
DESK TOP PUBLISHING			
241	Pacific Data Products, Inc.	Pacific Page I/P	302
299	SWFTE International, Ltd	Glyphix	37
DATA ENTRY SOFTWARE			
362	OCR Systems	Read Right	42
VERTICAL MARKET SOFTWARE			
382	Data General	Aviion Family/Portable Netware	203
291	Map Info	Map Info Database	412
EDUCATIONAL SOFTWARE			
188	PC Globe	PC Globe Software	225
ENTERTAINMENT SOFTWARE			
188	PC Globe	PC Globe Software	225
FORM DESIGNERS			
250/734	Delrina Technology	Perform Pro	166
257	Indigo Software Ltd	Form Designers	342
PRE-PRINTED FORM SOFTWARE			
380	Bloc Publishing	Form Tool	70
DIAGNOSTIC SOFTWARE			
340	Touchstone Software Corp.	Check It	28
MAPPING SOFTWARE			
291	Map Info	Map Info Database	412
221	Strategic Mapping Inc.	Mapping Software	151
FLOWCHARTING			
301	Patton & Patton	Flow Charting Software	358
124	Roytore, Inc.	ABC Flowcharter	442
WINDOWS SOFTWARE			
505	Asymetrix Corp.	Windows Software	278-279
*	Microsoft	Windows	218-221
124	Roytore, Inc.	ABC Flowcharter	442
COMPATIBLE KEYBOARDS			
179	Jameco Electronics	Mail Order	483
*	Northgate Computer Systems	Compatible Keyboards	139
*	Northgate Computer Systems	Compatible Keyboards	434
*	Northgate Computer Systems	Compatible Keyboards	344-345
388	Zeos International	Keyboard	29
DISK BACKUP & TAPE DRIVES			
521	3M Data Recording Products Division	Data Storage Product	208-209
749	Central Point Software	PC Tools Deluxe	66-67
473	Colorado Memory Systems, Inc	Storage-Jumbo Tape Back-Up	289
495	Maynard Electronics	Dat Tape Backup	214
317	Megadrive Systems, Inc.	Removable Hard Drives	90
390	Micro Solutions	Floppy Disk Drives	276
190	Procom Technology	Storage Peripherals	202
268	Swan Technologies	Tape Back-Ups	143-147
384	Tecmar Inc	Mass Storage/Tape Drives	223
HARD DISKS			
198	Core International	Hard Rive	127
162	Gibson Research	SpinRite II	428
*	Hard Drives International	Mail Order	494
317	Megadrive Systems, Inc.	Removable Hard Drives	90
283	Plus Development	Hardcard II	183
190	Procom Technology	Storage Peripherals	202
737	Vicon Corporation	Conner, WD, Maxtor, etc.	497
CHIPS PROCESSORS			
*	Intel Corp	32 bit Processors	437
512	Intel Corp.	32 bit Processors	439
COMPUTERS/COMPATIBLES			
519	Acer Technologies	PC s	359
129	Acma Computers, Inc	Mail Order	164-165
520	Advanced Logic Research	PC's	2-3
166	AST Research	386 SX	177
509	Austin Computers	PC s	9-11
*	Compaq Computer Corporation	PC s	386-387
*	Compu Add	PC s	169-174
382	Data General	Aviion Family/Portable Netware	392-393
*	Dataworld	PC s	100-101
536	Dell Computer Corporation	Dells PC's	C5-6
527	Dell Computer Corporation	Dells PC s	230-233
532	Dell Computer Corporation	Dell s PC s	22-23
383	DR Discount Computers	Computers/Compatibles	4
133	Dyna Micro, Inc.	IBM Compatible-486	222
*	Epson	Epson Desktop Computers	300-301
479	Ergo Computing Inc	PC	310-311
*	Everex Systems, Inc	Systems & Consulting	251-252
216	Everex Systems, Inc	Systems & Consulting	253-254
*	EXCEL MICRO	Computers/Compatibles	480
*	Gateway 2000	Compatibles	48c-h
525	Hyundai	PC s	457
*	IBM Corp	IBM Risc System 6000	106-107
512	Intel	Computers	437/439
179	Jameco Electronics	Mail Order	483
472	Leading Edge	PC's	92-93
*	Lotus Development	123/G	78-79
331	Microway	Co-Processors	111
321	Mitsuba Corp	PC's	176
195	National TeleVAR	DTP Workstation	424-425
*	NEC Technologies	386 SX	450-451
*	Northgate Computer Systems	Compatibles	139
*	Northgate Computer Systems	Computers/Compatibles	434
*	Northgate Computer Systems	Computers/Compatibles	204-205
*	Northgate Computer Systems	Computers/Compatibles	306-307
*	Northgate Computer Systems	Computers/Compatibles	344-345
*	Northgate Computer Systems	Computers/Compatibles	360-361
*	Northgate Computer Systems	Computers/Compatibles	444-445
*	Northgate Computer Systems	Computers/Compatibles	156-157
122	Panasonic OA	Desktop	98
271	Pao-Ku Ltd	Compatibles, Mail Order	492
303	PC Brand	Compatibles, Mail Order	396-405
366	Samsung Information Systems	Computers/Compatibles	158
163	Standard Computers (CPU)	PC s	50-51
163	Standard Computers (CPU)	Compatibles	50-51
*	Sun Moon Star	Sun Moon Star 386SX	160-161
268	Swan Technologies	Computers	144-147
391	Tangent Computer, Inc	PC's	87
208/123	Telemart	PC's	84-87
533	Touche	Compatibles	148
121	Tri-Star Computer	PC s	17
737	Vicon Corporation	Vicon Corporation	497
211	Xircom	Ethernet Adapter Cards	108
*	Zeos International	Compatibles	129-136
*	Zeos International	Compatibles	329-336
*	Zeos International	Portable	191-198
*	Zeos International	Compatibles	371-378
388	Zeos International	Keyboard	29
484	Zeos International	Z-Card	137
115	Zeos International	Z-Card	199
745	Zeos International	Z-Card	337
739	Zeos International	Z-Card	379
145	Zeos International	Compatibles	30-31
721	Zeos International	Compatibles	72-73
INPUT DEVICES			
144	Calcomp	WIZ	270-271
522	Calera Recognition Systems	OCR - Input Devices	248
742	Diamond Flower Electric Instruments	DMS 400 Mouse	250
266	IMCS	Mouse Pen	265
334	IMCS	Mouse Pen	267
*	Kensington Microware Ltd	Expert Mouse	213
492	Kye International	Mouse	273
*	Microsoft	Mouse	478-479
120	Mouse Systems	Mouse	227
116	Mouse Systems	Mouse	229
362	OCR Systems	Read Right	42
PROGRAMMERS TOOLS UTILITIES			
*	Ashton Tate	Control Room	189
505	Asymetrix Corp.	Windows Software	278-279
236	Fifth Generation	Utility	203
338	Quarterdeck Office Systems	Multitasking Utilities	201
ADD-ON BOARDS			
128	Capital Equipment Corporation	Add In Boards	208
276	Hauppauge	386 Motherboards	32
142	Intel (PCEO)	Q Ram	163
325	IQ Engineering	IQ Super Cartridge	105
370	Micron Technology	Memory Boards & Video Products	409
327	Paradise/Western Digital Imaging	VGA Boards	152
268	Swan Technologies	VGA Boards	144-147
737	Vicon Corporation	Add-on Boards	497
SCANNERS/DIGITIZERS			
742	Diamond Flower Electric Instruments	HS3000 + Handyscanner	250
492	KYE International	Scanner	273
492	KYE International	Digitizer Tablet	273
362	OCR Systems	Read Right	42
PRINTERS			
242	Alps America	Allegro 500 Printer	362
730	Brother International	DOT Matrix Printers	468
328	Buffalo Products	Printing Utility	305

RS#	ADVERTISER	PRODUCT	PAGE#
187	Canon, USA	Laser Beam Printer	91
155	Canon, USA	Bubble Jet 10e Portable	356-357
353	Eastman Kodak	Printers	264
491	Hewlett Packard-Peripheral Group	Laser Jet III	244-245
326	Hewlett Packard-Peripheral Group	Paint Jet	338
•	IBM Corp	Laser Printer	319
325	IQ Engineering	IQ Super Cartridge	105
179	Jameco Electronics	Mail Order	483
195	National TeleVAR	DTP Workstation	424-425
•	NEC Technologies	P6300 Dot Matrix Printer	308
241	Pacific Data Products, Inc.	Pacific Page IIP	302
138	Panasonic OA	Laser Printers	414
381	Panasonic OA	1100 Series Printer	347
259	QMS	Printers	5
289	Tandy Corporation	Color Printer	466
218	Tektronix	Color Printer	274-275
177	Texas Instruments	Micro Laser	12-13
HAND-HELD PC'S			
333	Poqet Computer	Hand Held PC	473
193	Sharp Electronics Corp.	Wizard	268
FLOPPY DISK DRIVES			
190	Procom Technology	Storage Peripherals	202
737	Vicon Corporation	Floppy Disk Drives	497
FONT CARTRIDGES			
132	Elexys	Font Cartridges	259
241	Pacific Data Products, Inc.	Pacific Page IIP	302
TRACK BALLS			
120	Mouse Systems	Trackball	227
PRINTER ACCESSORIES			
328	Buffalo Products	Printing Utility	305
214	Digital Products	Printer Sharing Device	272
268	Fifth Generation	Printer Sharing	260-261
325	IQ Engineering	IQ Super Cartridge	105
726	Kansai International	Printer Sharing Device	449
241	Pacific Data Products, Inc.	Pacific Page IIP	302
290	Rose Electronics	Printer Sharing	268
737	Vicon Corporation	Panasonic	497
PORTABLE/LAP COMPUTERS			
382	Data General	Avion Family/Portable Network	392-393
212	Dotch Computers	Dotch P.A.C.	57
321	Mitsuba Corp	Laptop	176
252	Panasonic OA	Laptop	465
271	Pao-Ku Ltd	Compatibles, Mail Order	499
371	Top PC's	Laptop	150
379	Toshiba of America	Laptop	238-239
211	Xircom	Ethernet Adapter Cards	108
•	Zeos International	Portable	191-198
PC-FAX			
231	Touchbase Systems	Portable Fax & Data Modem	200
210	Zoom Telephonics Inc.	Modems	56
CO-PROCESSORS			
331	Microway	Co-Processors	111
737	Vicon Corporation	Cyrix, IIT, Intel	497
OPTICAL PERIPHERALS			
190	Procom Technology	Storage Peripherals	202
346	Specialty Software	Math Coprocessor	295
MEMORY SUBSYSTEMS			
190	Procom Technology	Storage Peripherals	202
OS/2 SOFTWARE			
•	Lotus Development	123/G	78-79
CD-ROM			
180	Bureau of Electronic Publishing	CD-Rom	16
190	Procom Technology	Storage Peripherals	202
CHIPS/PROCESSORS			
331	Microway	Co-Processors	111
346	Specialty Software	Math Coprocessor	295
737	Vicon Corporation	Draw, Simms, Sips	497
DISPLAYS/MONITORS/TERMINALS			
321	Mitsuba Corp	Monitors	176
195	National TeleVAR	DTP Workstation	424-425
335	Nec Home Electronics Inc	Monitors	24-25
746	Panasonic OA	C1381 Monitor	226
395	Sharp Professional Products	Overhead Projector	47
294	Tatung	Monitors	257
737	Vicon Corporation	Hires VGA	497
GRAPHICS SOFTWARE			
505	Asymetrix Corp	Windows Software	278-279
498	Corel Systems	Corel Draw 1.2	327
151	Hewlett-Packard/Netwk Sys. Group	New Wave Software	184-185
•	Lotus Development	Freelance Plus	299
•	Micrografx	Designer	20
•	Microsoft	Power Point	262-263
362	OCR Systems	Read Right	42
124	Roytons, Inc.	ABC Flowcharter	462
•	Software Publishing	Harvard Graphics	141
PLOTTERS/CHARTING DEVICES			
241	Pacific Data Products, Inc.	Pacific Page IIP	302
VIDEO GRAPHICS/BOARDS			
540	ATI Technologies Inc.	VGA Wonder	280
370	Micron Technology	Memory Boards & Video Products	409
327	Paradise/Western Digital Imaging	VGA Boards	152
ACCELERATOR BOARDS			
142	Intel (PCEO)	Q RAM	163
COMMUNICATIONS SOFTWARE			
293	3 Com	3+ Open Server	366-367
328	Buffalo Products	Printing Utility	305
749	Central Point Software	PC Tools Deluxe	66-67
382	Data General	Avion Family/Portable Network	392-393
504	DATASTORM TECHNOLOGIES	Procomm Plus	318
278	DCA	Crosstalk	298
332	Dynamic Microprocessor Assoc	PC Anywhere IV	391
735	Triton Technologies	Communications Software	210
LOCAL AREA NETWORKING			
254	Artsoft	Vonos Lan	341
328	Buffalo Products	Printing Utility	305
483	ConnectWorks	LAN	478
382	Data General	Avion Family/Portable Network	392-393
•	DCA	Irma 3	419
147	DCA	Irma 3	420
214	Digital Products	Printer Sharing Device	272
243	DSC Communications	DSC Nexos	423
330	Dynamic Microprocessor Assoc.	PC Anywhere IV LAN	65
268	Fifth Generation	Logical Connection	260-261
146	Gateway Communications	Ethernet Board	187
•	Northgate Computer Systems	Computers/Compatibles	204-205
•	Northgate Computer Systems	Computers/Compatibles	360-361
342	Protec Microsystems, Inc.	ByteLink	433
290	Rose Electronics	Printer Sharing	268
230	US Sage	Main Lan	385
211	Xircom	Ethernet Adapter Cards	108
MICRO-MAINFRAME LINKS			
296	Attachmate	Windows Version of Extra!	76
MODEMS			
179	Jameco Electronics	Mail Order	483
367	Universal Data Systems	Fastalk Modem	474
737	Vicon Corporation	Modems	497
210	Zoom Telephonics Inc.	Fax	56

RS#	ADVERTISER	PRODUCT	PAGE#
EMULATORS/PROTOCOL CONVERTERS			
241	Pacific Data Products, Inc.	Pacific Page IIP	302
MULTIUSER SYSTEMS			
382	Data General	Avion Family/Portable Network	392-393
342	Protec Microsystems, Inc.	ByteLink	433
230	US Sage	Main LAN	385
SOFTWARE MEDIA SHARING			
234	3X USA	3X-Link 16	45
PERIPHERAL SHARING DEVICE			
328	Buffalo Products	Printing Utility	305
342	Protec Microsystems, Inc.	ByteLink	433
DISKETTES			
521	3M Data Recording Products Division	Data Storage Product	208-209
MAINTENANCE			
382	Data General	Avion Family/Portable Network	392-393
POWER PROTECTION			
281	American Power Conversion Corp	UPS	380
382	Data General	Avion Family/Portable Network	392-393
152	Emerson Electric Co	UPS	55
181/378	Iomega Corporation	Bernoulli Box	353-355
SECURITY			
286	Fifth Generation	Security	62
PC ACCESSORIES			
•	Curtis Manufacturing	Accessories	103
TRAINING/SEMINARS			
382	Data General	Avion Family/Portable Network	392-393
MAIL ORDER			
129	Acme Computers, Inc.	Mail Order	164-165
336	Arlington Computer Products	Mail Order	485
481	Bull Dog Computer Products	Mail Order	498
273	Bus Computer	Mail Order	481
109	Comp. Discount Warehouse (MMC)	Mail Order	493
205	Compuclassics	Mail Order	52
274	Computability	Mail Order	495
246	Computer Direct	Mail Order	491
319	Darmark International	Mail Order	496
532	Dell Computer Corporation	Dells PC's	22-23
527	Dell Computer Corporation	Dells PC's	230-233
536	Dell Computer Corporation	Dell's PC's	CS-8
383	DR Discount Computers	Mail Order	4
347	Dustin Discount Software	Mail Order	14
•	EXCEL MICRO	Mail Order	480
282	First Source International	Mail Order	492
•	Gateway 2000	Compatibles	48a-h
•	Hard Drives International	Mail Order	494
179	Jameco Electronics	Mail Order	483
225	Micro Warehouse	Mail Order	458-460
331	Microway	Co-Processors	111
489	Midwest Computer Works	Mail Order	488
•	Northgate Computer Systems	Mail Order	488
•	Northgate Computer Systems	Mail Order	156-157
•	Northgate Computer Systems	Mail Order	139
•	Northgate Computer Systems	Mail Order	434
•	Northgate Computer Systems	Mail Order	204-205
•	Northgate Computer Systems	Mail Order	306-307
•	Northgate Computer Systems	Mail Order	344-345
•	Northgate Computer Systems	Mail Order	360-361
•	Northgate Computer Systems	Mail Order	444-445
271	Pao-Ku Ltd	Mail Order	499
303	PC Brand	Compatibles, Mail Order	396-405
•	PC Connection	Mail Order	288-293
295	RP Systems	Mail Order	490
349	S&W Computers	Mail Order	497
108	SAI Systems	Mail Order	484
163	Standard Computers (CPU)	Compatibles	50-51
268	Swan Technologies	Mail Order	143-147
123/206	Telemart	Mail Order	84-87
209	Thoroughbred Microsystems	Mail Order PC's	489
533	Touche	Compatibles	148
737	Vicon Corporation	Vicon Corporation	497
171	Warehouse Data Products	Mail Order	482
•	Zeos International	Compatibles	129-136
•	Zeos International	Compatibles	329-336
•	Zeos International	Portable	191-198
•	Zeos International	Compatibles	371-378
388	Zeos International	Keyboard	29
484	Zeos International	Z-Card	137
115	Zeos International	Z-Card	199
745	Zeos International	Z-Card	337
739	Zeos International	Z-Card	379
145	Zeos International	Compatibles	30-31
721	Zeos International	Compatibles	72-73
ON LINE DATABASE			
226	Compuserve Information Service	On-Line Service	320
137	CUC International	Compu-Store On-Line Service	497
LEASING			
382	Data General	Avion Family/Portable Network	392-393
ELECTRONIC MAIL			
382	Data General	Avion Family/Portable Network	392-393
CONSULTING			
382	Data General	Avion Family/Portable Network	392-393
107	Computer Info. Specialists	Systems & Consulting	247
APPLE PRODUCTS			
251	Apple Computer	Mac PC's	124-125
•	Sotor Corporation	Project Scheduler 4	60
UNIX PRODUCTS			
382	Data General	Avion Family/Portable Network	392-393
MISCELLANEOUS			
291	Map Info	Map Info Database	412
221	Strategic Mapping Inc	Mapping Software	151
DIRECT MARKETING CONNECTION			
336	Arlington Computer Products	Mail Order	485
481	Bull Dog Computer Products	Mail Order	498
273	Bus Computer	Mail Order	481
109	Comp. Discount Warehouse (MMC)	Mail Order	493
274	Computability	Mail Order	495
246	Computer Direct	Mail Order	491
137	CUC International	Mail Order	497
319	Darmark International	Mail Order	496
•	EXCEL MICRO	Mail Order	480
352	Fastmicro	Mail Order	486-487
282	First Source International	Mail Order	492
•	Hard Drives International	Mail Order	494
179	Jameco Electronics	Mail Order	483
489	Midwest Computer Works	Mail Order	488
271	Pao-Ku Ltd	Mail Order	499
295	RP Systems	Mail Order	490
349	S&W Computers	Mail Order	497
108	SAI Systems	Mail Order	484
209	Thoroughbred Microsystems	Mail Order	489
737	Vicon Corporation	Mail Order	497
171	Warehouse Data Products	Mail Order	482

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COMING UP

■ ILLUSTRATION SOFTWARE

The state of the art in freehand drawing software has taken another leap, with improved text and color handling and more-sophisticated tracing. PC Labs tests five high-end drawing packages, including *MicroGrafx Designer* and *Corel Draw!*, previews a much enhanced version of Digital Research *ArtLine*, and evaluates two standalone autotracing packages.

■ PCs: 486 ISA

The new generation of 486 ISA bus systems is here. In *PC Magazine*'s first roundup of machines based on the new chip, we test more than 25 systems from vendors such as ALR, CompuAdd, Gateway 2000, and Northgate. It's the 486 chip, with its built-in coprocessor and 8K RAM cache, that makes these 25-MHz screamers much faster than their 33-MHz 386 counterparts.

■ WINDOWS 3.0

Bill Hall, *PC Magazine*'s Windows columnist, takes a look at this long-awaited release. Full benchmark testing, and performance and configuration tips, give you the whole story on one of the most important PC system software releases ever.

■ LAN CONTROL AND REPORTING SOFTWARE

PC LAN Labs looks at software intended to help LAN administrators monitor the usage of networked resources. Products include Network Management's *LANTrail* and The Aldridge Co.'s *Precursor*.

■ LOW-COST PROJECT MANAGEMENT

Balancing time, money, and resources requires the kind of planning tools that project management software offers. Fortunately, new graphical interfaces are making some low-end packages easier for the part-time project manager to use. PC Labs tests seven such packages under $700, including the latest version of Symantec's *TimeLine* and the long-awaited *Microsoft Project for Windows*. ■

After Hours

Products for the Leisure Side of Personal Computing

Legal Software Offers Help with Preparing Wills And Other Documents

In the ideal case, your PC—with the appropriate software—could substitute for a lawyer in dispensing legal advice. After all, the Law (capital L) is just a codified set of rules, and if there's one thing that the computer is good at, it's following rules. The problem is that these rules fill entire libraries, are sometimes contradictory, and often don't make sense—even to lawyers. Since a real understanding of the Law still lies beyond the PC's ken, legal software is forced into a more modest role. Typically, packages like *Expert Will* ($14.95 from Expert Software), *Hyatt Legal Services Home Lawyer* ($119.95 from Meca Ventures), *It's Legal* ($49 from Parsons Technology), *Personal Lawyer* and *Personal Lawyer/Lifestyles* (each $59.95 from BLOC Publishing), and *WillMaker* ($69.95 from Nolo Press) do little more than a stenographer; they type out documents for you. You fill in the blanks, and the program types out a completed legal document.

All of these products (except *Personal Lawyer/Lifestyles)* have the ability to generate wills. In fact, two of them—*Expert Will* and *WillMaker*—do nothing more than that.

Home Lawyer, It's Legal, and *Personal Lawyer* go beyond wills to offer a mix of additional forms. They handle general and special powers of attorney and their revocations, residential leases, and promissory notes. *Personal Lawyer* and *It's Legal* also include guardianships. *Home Lawyer* adds bills of sale, employment and independent contractor agreements, and several specialized letters.

Besides these basics, *It's Legal* also includes living wills (which let you ask doctors to refrain from heroic measures) and commercial leases. *Personal Lawyer/Lifestyles* avoids wills entirely and takes aim solely at today's trendiest legal complications: pre- and postnuptial, marital settlement, and living-together agreements as well as statements of guardianship.

In approach they are all much the same; all ask questions and give you an opportunity to answer. Then they put your information into blanks in boilerplate legalese (boilerplate because it's been proved strong enough to withstand assaults and legal challenges).

Yes, you could do the same thing by buying a form in the stationery store. Where legal software differs, however, is in guidance. These programs attempt (sometimes successfully) to structure and organize your thinking. They help you make the right decisions by either providing advice or limiting what is included and excluded from the final document.

LEAVING A WILL

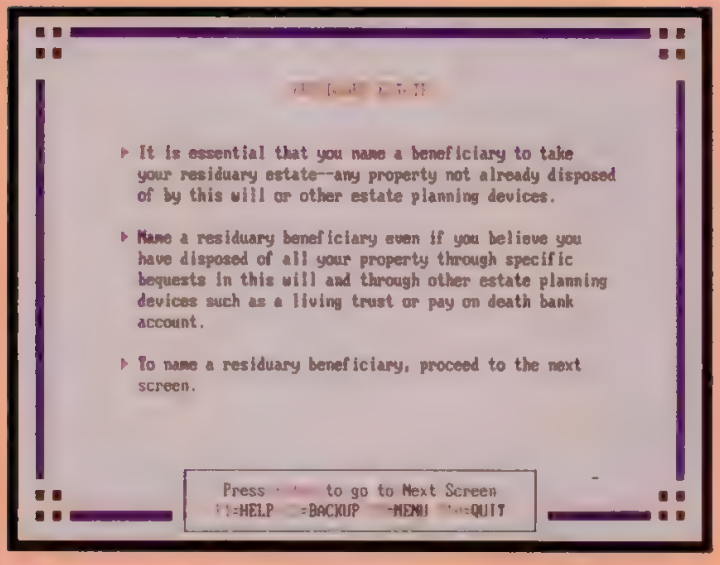
The will-writing sections of all of these programs create wills that meet the legal requirements in all states except Louisiana (which has a unique legal system based on the Code Napoleon). All of them pull in boilerplate to assure that your wishes are properly carried out. In addition, by querying you, they force you to include details you might otherwise forget: naming an executor, a guardian for the kids, or what to do with the residue of your estate.

Expert Will gives the least help. Its 16-page manual (the same size as an enclosed catalog) tells you almost nothing about the law. Overall, the program is clumsy; its data entry component looks like a database screen, and it doesn't show you anything of the finished document until you print it to paper or screen.

The rest of these legal aids give some general guidance. *WillMaker* does the best job, giving you background both on the screen (in prompts and its three layers of help) and in its manual. It also customizes the will to the state in which you live. The rest of the programs cover all the bases and include requirements that may not be needed in your own jurisdiction.

Home Lawyer creates the simplest will, while the others spoon in more complex boilerplate. In the final analysis, all should prove equally effective, though the list of community property states given by *Personal Lawyer* is not entirely correct.

CONTINUES



Of the software we examined, *WillMaker* does the best job of helping you put your worldly affairs in order.

GAMES
Lucasfilm's *Loom* breaks new ground in adventure games.

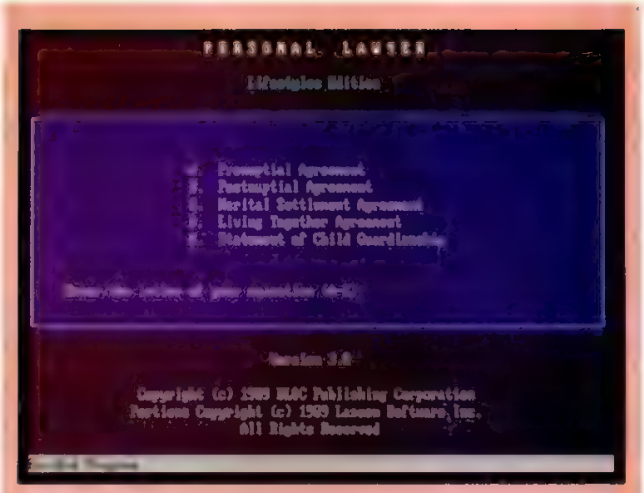
Shufflepuck Cafe. Air hockey for your PC screen

Legal

CONTINUED

The programs differ in their approach to issues beyond the simplest will. You may be afraid, for example, that your son at 18 will be overcome by hormones and invest his inheritance in hot cars or lottery tickets rather than his education. *It's Legal*, *WillMaker*, and *Expert Will* all have at least rudimentary provisions for delaying the time at which minors get control of their inheritance. Again, *WillMaker* is best, giving options allowed by the Uniform Gifts to Minors Act as well as the children's trusts offered by the other two programs.

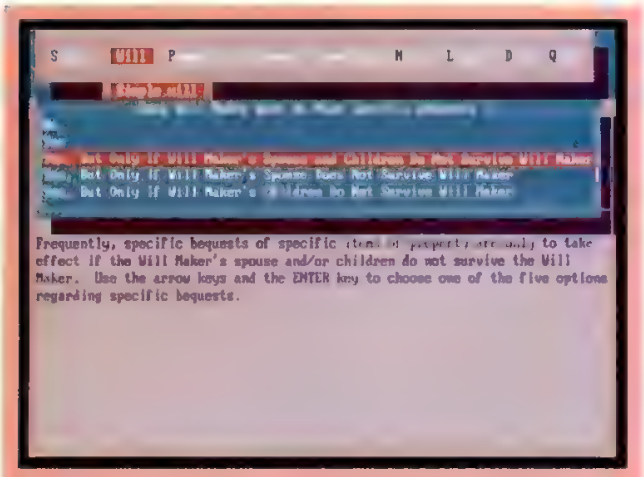
Another point of departure is how each program lets you cut someone out of your will. Some make an effort at helping you. *Home Lawyer*, however, advises that you see a real lawyer. Considering the sticky issues involved, that's reasonable advice.



***Personal Lawyer/Lifestyles* deals entirely with issues that arise when people live together.**

document actually means, the general rule of thumb is that the ambiguities are resolved against the person who drafted the document—potentially you and your PC.

As computer software rather than as legal advisers, these programs are even more disappointing; they rarely tap the power of your PC. The most



***It's Legal* helps the user compose a legal will by asking a series of questions and suggesting likely answers.**

A point-by-point comparison of the general-interest packages (*Home Lawyer*, *It's Legal*, and *Personal Lawyer*) is unnecessary. All the documents created have legal effect, and they handle the situations that they purport to reasonably well. But again, what you create won't necessarily be better than the form you buy in a store.

Worse, when a court tries to figure out what an ambiguous

they do is check your dates and math (although you can blithely make your children older than you).

Home Lawyer and *It's Legal* offer moving-bar menus for selecting forms, and *It's Legal* even has mouse support. Both *Home Lawyer* and *It's Legal* provide on-line help, and *It's Legal* also has a rudimentary two-page notepad and permits shelling out to DOS. But the average *Microsoft Windows* application makes any of these programs appear hacked out of the Stone Age.

WillMaker makes the best use of your hardware investment. As the program goes along, it splits the screen to display each answer you add, in context, and gives you a chance to revise your responses as you go along. Optional screens of background material and advice can be interspersed.

In some cases, the documentation is the best part of the package. *Personal Lawyer/Lifestyles*, for example, includes a small background reference guide that highlights important legal issues. Its companion, *Personal Lawyer*, proved much less satisfactory, however.

PICKING PROGRAMS

In selecting any of these products, your first consideration should be whether to buy legal software at all. Having an attorney craft a simple will may actually cost less than some of these programs. Lawyers may in fact benefit more from this software than lay folk—except that the *WillMaker* license does not extend to professional use.

On the other hand, if you routinely generate leases, promissory notes, or other simple legal documents, and you have a good idea of what you're doing, you may find one of the form-generating programs valuable. The software would also justify itself if it induces someone who otherwise wouldn't have any will at all to sit down and compose one.

That's a good reason if you should believe, as some people do, that any will is better than no will at all. This can be true, but remember—the government doesn't automatically get everything if you don't have a will. Your estate usually goes to your next of kin as specified by state law. You need a will if that's not the choice you prefer.

If you opt for a computer-generated will, the program of choice is *WillMaker*. It offers the best advice and is the least likely to get you in trouble. If your legal needs require more breadth, however, go with *It's Legal*. *Personal Lawyer/Lifestyles* is the only choice for cohabitation agreements, though if matters are so knotty that you need an agreement, the price of anticipatory professional counseling will likely be worthwhile in the long run.

List Price: *Expert Will*, $14.95. **Requires:** 384K RAM, DOS 2.1 or later. Expert Software, P.O. Box 1911, Murray Hill Station, New York, NY 10156.

CIRCLE 404 ON READER SERVICE CARD

List Price: *Hyatt Legal Services Home Lawyer*, $119.95. **Requires:** 256K RAM, DOS 2.0 or later. Meca Ventures Inc., 327 Riverside Ave., Westport, CT 06889; (203) 226-2400.

CIRCLE 405 ON READER SERVICE CARD

List Price: *It's Legal*, $49. **Requires:** 384K RAM, DOS 2.0 or later. Parsons Technology, 375 Collins Rd. NE, Cedar Rapids, IA 52402; (319) 395-9626.

CIRCLE 406 ON READER SERVICE CARD

List Price: *Personal Lawyer (General Edition)* and *Personal Lawyer/Lifestyles*, $59.95. **Requires:** 256K RAM, DOS 2.0 or later. BLOC Publishing, 800 SW 37th Ave., #765, Coral Gables, FL 33134; (305) 445-0903.

CIRCLE 407 ON READER SERVICE CARD

List Price: *WillMaker* 4.0, $69.95. **Requires:** 256K RAM, DOS 2.1 or later. Nolo Press, 950 Parker St., Berkeley, CA 94710; (800) 992-6656, in California, (800) 445-6656 or (415) 549-1976.

CIRCLE 408 ON READER SERVICE CARD

INDEX TO ADVERTISERS

RS #	ADVERTISERS	PAGE
293	3 Com	366-367
521	3M Data Recording Products	208-209
234	3X USA	45
519	Acer Technologies	359
129	Acma Computers, Inc.	164-165
520	Advanced Logic Research	2-3
242	Alps America	362
736	American Fundware	477
281	American Power Conversion Corp.	380
475	American Small Business	71
251	Apple Computer	124-125
336	Arlington Computer Products	485
254	Artisoft	341
*	Ashton Tate	189
166	AST Research	177
505	Asymetrix Corp.	278-279
540	ATI Technologies	280
296	Attachmate	76
509	Austin Computers	9-11
119	Baler Software	21
380	Bloc Publishing	70
287	Borland International	446
285	Borland International	452
730	Brother International	469
328	Buffalo Products	305
481	Bulldog Computer Products	498
180	Bureau of Electronic Publishing	16
273	Bus Computer	481
144	Calcomp	270-271
522	Calera Recognition Systems	248
155	Canon, USA	356-357
187	Canon, USA	91
128	Capital Equipment Corp.	206
749	Central Point Software	66-67
117	Chronologic Corp.	155
178	Clarion Software	298
473	Colorado Memory Systems, Inc.	269
*	Compaq Computer Corp.	386-387
*	CompuAdd	169-174
205	Compuclassics	52
226	Compuserve Information Service	320
274	Computability	495
375	Computer Associates	286
*	Computer Associates	470
246	Computer Direct	491
109	Computer Discount Warehouse (MMC)	493
107	Computer Info Specialists	247
315	Concentric Data Systems	285
483	ConnectWorks	476
198	Core International	127
496	Corel Systems	327
194	Cougar Mountain Software	277
137	CUC International	497
*	Curtis Manufacturing	103
319	Damark International	496
382	Data General	392-393
354	Data Pro Accounting S.W.	443
504	DATASTORM TECHNOLOGIES	318
*	Dataworld	100-101
*	DCA	419
147	DCA	420
278	DCA	296
536	Dell Computer Products	C5-C8
527	Dell Computer Products	230-233
532	Dell Computer Products	22-23
250/734	Delrina Technology	168
742	Diamond Flower Electric	250
214	Digital Products	272
212	Dolch Computers	57
383	DR Discount Computers	4
243	DSC Communications	423
347	Dustin Discount Software	14
133	Dyna Micro Inc.	222
332	Dynamic Microprocessor Associates	391
330	Dynamic Microprocessor Associates	65
363	Eastman Kodak (copy Products)	264
132	Elesys	259
152	Emerson Electric Co.	55
*	Epson	300-301
479	Ergo Computing Inc.	310-311
16	Everex Systems, Inc.	251-254
*	EXCEL MICRO	480
352	FASTMICRO	486-487
286	Fifth Generation	62
288	Fifth Generation	260-261
236	Fifth Generation	203
282	First Source International	492
112	Fox Software Inc.	68
224	Franklin Software	82
323	Funk Software	80
*	Gateway 2000	48a-h
146	Gateway Communications	187
506	Generic Software	207
162	Gibson Research	428
*	Hard Drives International	494
276	Hauppauge Computer	32
313	Helix Software	406
326	Hewlett Packard Peripheral Group	338
491	Hewlett Packard Peripheral Group	243-245
151	Hewlett Packard Network Systems Group	184-185
525	Hyundai	457
*	IBM Corp.	319
*	IBM Corp.	83
*	IBM Corp.	106-107
*	IBM Corp.	395
266	IMCS	265
334	IMCS	257
257	Indigo Software	342
142	Intel	163
*	Intel	437
512	Intel	439
265	Intergraph Corp.	413
*	Intuit Software	40-41
378/181	Iomega Corp.	353-355
325	I.Q. Engineering	105
179	Jameco	483
726	Kansai Electric	449
*	Kensington Microware Ltd.	213
492	KYE International	273
201	Lahey Computer Systems	206
472	Leading Edge	92-93
*	Lotus Development Corp.	78-79
*	Lotus Development Corp.	299
*	Lotus Development Corp.	39
263	Macola Inc.	18-19
291	Map Info.	412
154	Mathsoft	455
495	Maynard Electronics	214
317	Megadrive Systems Inc.	90
390	Micro Solutions	276
225	MicroWarehouse Inc.	458-460
*	Micrografx	20
370	Micron Technology	409
539	Microrim	348
*	Microsoft	C2-C4
*	Microsoft	1
*	Microsoft	218-219
*	Microsoft	221
*	Microsoft	478-479
*	Microsoft	262-263
331	Microway	111
489	Midwest Computer Works	488
321	Mitsuba Corp.	176
120	Mouse Systems	227
116	Mouse Systems	229
170	Multisoft Corp.	456
195	National TeleVAR	424-425
335	NEC Home Electronics Inc.	24-25
*	NEC Technologies, Inc.	308
*	NEC Technologies, Inc.	450-451
*	Northgate Computer Systems	156-157
*	Northgate Computer Systems	139
*	Northgate Computer Systems	434
*	Northgate Computer Systems	204-205
*	Northgate Computer Systems	306-307
*	Northgate Computer Systems	344-345
*	Northgate Computer Systems	360-361
*	Northgate Computer Systems	444-445
362	OCR Systems	42
*	Oracle	88
241	Pacific Data Products	302
122	Panasonic OA	98
138	Panasonic OA	414
746	Panasonic OA	226
252	Panasonic OA	465
381	Panasonic OA	347
271	Pau-Ku Ltd.	499
327	Paradise/Western Digital Imaging	152
301	Patton & Patton	358
303	PC Brand	396-405
*	PC Connection	288-293
188	PC Globe	225
140	PC Publishing	369
283	Plus Development	183
333	Poqet Computer	473
148	Primavera Systems	58
190	Procom Technology	202
342	Protec Microsystems, Inc.	433
259	QMS	5
338	Quarterdeck Office Systems	201
290	Rose Electronics	268
124	Roykore, Inc.	442
295	RP Systems	490
349	S & W Computers	497
108	SAI Systems	484
366	Samsung Information Systems	158
*	Scitor Corp.	60
193	Sharp Electronics Corp.	266
395	Sharp Professional Products	47
393	Software Link, Inc.	74
*	Software Publishing	255
*	Software Publishing	141
346	Specialty Software	295
103	SPSS Inc.	178
163	Standard Computer Corp.	50-51
221	Strategic Mapping Inc.	151
*	Sun Moon Star	160-161
268	Swan Technologies	143-147
299	SWFTE International	37
264	Symantec	26
289	Tandy Corp.	466
391	Tangent Computer, Inc.	97
294	Tatung Company of America	257
384	Tecmar	223
218	Tektronix	274-275
123	Telemart	84-85
206	Telemart	86-87
177	Texas Instruments	12-13
209	Thoroughbred Microsystems	489
371	TOPPCs	150
379	Toshiba of America	238-239
231	Touchbase Systems	200
533	Touche'	148
340/341	Touchstone Software Corp.	28
121	Tri-Star Computer	17
735	Triton Technologies	210
367	Universal Data Systems	474
230	US Sage	385
737	Vicon Corporation	497
171	Warehouse Data Products	482
*	Wordperfect	94
211	Xircom	108
518	Xyquest	82
484	Zeos International	129-137
115	Zeos International	191-199
745	Zeos International	329-337
739	Zeos International	371-379
388	Zeos International	29
145	Zeos International	30-31
721	Zeos International	72-73
210	Zoom Telephonics Inc.	56

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Lucasfilm's Graphic Loom Weaves a Colorful Fabric Of Imaginative Adventure

GAMES
by Stephanie Loose

While other PC game publishers have focused their efforts on improving graphics and sound, Lucasfilm Games has redefined the entire concept of the role-playing adventure game. The company's latest release, *Loom*, is an entrancing journey into a musical fantasy. With its innovative interface and fable-like plot, *Loom* could easily inspire a host of imitators.

The loom's ominous pattern foretells the destiny of the doomed Guild of Weavers. Musical spells advance the action of Lucasfilm's graphic adventure.

The story begins in the mythical Age of the Great Guilds. Professional societies ply their trades and form powerful city-states to defend their secrets. The peaceful Guild of Weavers has isolated itself on the island of Loom for safety from other warlike Guilds.

The Weavers' talents are not limited to the crafting of exquisite fabric; they also weave spells into their cloths. As the novice weaver Bobbin Threadbare, you must use all of your guild's powerful magic to help you find and rejoin your fellow guild members. Early in the game, they mysteriously turn into swans and fly away from the island.

As you travel outside of the island of Loom, you use a weaver's "distaff" (a sort of magic wand) to cast spells, or "drafts," as they are called. The drafts aid you in your quest.

Lucasfilm has developed a completely new interface, based on music notation, for the casting of spells. A musical staff appears at the bottom of your screen, and you cast a draft by clicking on the notes of the scale in the correct order. As you figure out the melody for each spell, you can write it down in the printed "book of patterns," which accompanies *Loom*'s documentation.

Loom doesn't require you to learn the commands or other vocabulary that are part and parcel of many other adventure games. The control mechanisms are so natural that the on-screen action seems like a direct translation of your thoughts. All of your interactions with the game can be controlled by a mouse or joystick. There are keyboard commands as well, but they seem awkward when compared to the simple, point-and-click flow of the mouse interface.

As you play, double-clicking on newly encountered objects triggers "cut-scenes," which are film-like episodes that advance the plot. These include conversations between characters, or information about an object itself. These cut-scenes give *Loom* a distinctly cinematic atmosphere.

The graphics are quite good. The scenes have a painted quality worthy of "oohs" and "aahs," and the animation is smooth and frequently elegant. The VGA graphics are not on the same level as the near-photographic screens found in some Access Software games, but not even Access has figured out how to sustain that level of detail over the course of an entire, complex adventure scenario.

Loom supports a variety of add-on sound hardware (though drivers for Roland's MT-32 must be either ordered separately or downloaded from CompuServe). If you don't have the additional audio equipment, you can still listen to background music and special effects played through the PC's rather meager built-in speaker. When the music gets on your nerves, which is inevitable if you are limited to the built-in speaker, you can toggle it off, keeping special effects active if you choose.

There's something indefinably upper crust about *Loom*. The theme music is by Tchaikovsky, and the language throughout the game is rich and lyrical. Of course, Lucasfilm still throws its trademark jibes and yuks your way, but somehow they manage not to break the mood.

In fact, mood is what *Loom* is all about. *Loom* is a kinder and gentler journey, not an ulcer-producing one. The game is designed from beginning to end to draw you in and hold your attention. Nothing comes between you and the action—not even the interface itself. Since you can't take a fatal step, there's no need to save the game every 20 seconds or agonize about vocabulary.

Loom comes with an audio tape that provides background on the history of the guilds and includes an introductory scene featuring the game's main characters. The narration by Lois Betterton is pure pleasure.

If anything, *Loom* is over too quickly, and, if you are an experienced gamer, you won't find it terribly difficult to master. For an additional challenge, you can play the game a second time at "expert" level, without the benefit of an on-screen musical staff to help you grasp the melodies that accompany the spells. In other words, you must play completely by ear. If you do manage to play through the game in expert mode, you will be rewarded with a bonus animated scene near the end of the game. Beyond that, there's nothing to do but pant for a sequel.

List Price: *Loom*, $59.95.
Requires: 512K RAM, color graphics, DOS 2.0 or later. Mouse or joystick optional.
Lucasfilm Games, P.O. Box 10307, San Rafael, CA 94912; (415) 662-1902.

CIRCLE 409 ON READER SERVICE CARD

Shufflepuck Cafe: Play Air Hockey With Aliens

GAMES
by Jonathan Marcus

As childhoods go, mine was far from deprived. But I never did get one of those ultra-cool air-hockey tables that floated a plastic disk on a frictionless cushion of air.

At last I am fulfilled, for Broderbund's *Shufflepuck Cafe* offers the software equivalent of the game I fell asleep dreaming of on so many suburban evenings. This arcade-style game quite faithfully translates air hockey to your EGA screen.

You find yourself at one end of the table, in control of a paddle that you manipulate with the keyboard, a joystick, or a mouse. As is often the case with arcade games, the keyboard is an ade-

CONTINUES

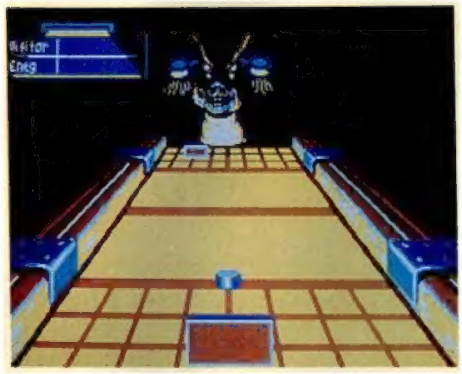
Shufflepuck

CONTINUED

quate but hardly optimal input device. A mouse works much better.

Just as in the real game, a tap from your paddle sends the puck skittering off in the direction of your opponent, chosen from a rogue's gallery of nine lost souls who patronize the dimly lit Shufflepuck Cafe. A point-and-click of your mouse summons your challenger to the table.

Each potential opponent has a different playing personality and skill level. The champion, Biff Raunch, is a biker type who delights in belittling you (sometimes through the PC's speaker) as he thrashes you at air hockey. Lexan Smythe-Worthington, who hails from a distant planet, plays a fairly respectable game, in between sips of an intoxicating beverage.



Broderbund's *Shufflepuck Cafe* lets you choose an opponent from a rogue's gallery of interstellar barflies.

To sharpen your playing edge, you can practice against a "training android." The android's level and style of play are highly configurable, so you can work on different aspects of your game. You can easily make changes, for instance, in the speed or force of his returns by selecting options from a pull-down menu bar.

After you've practiced for awhile and tested yourself against a few of your potential opponents, you may want to try *Shufflepuck Cafe*'s tournament mode, in which you strive to beat all comers and claim the championship.

The best PC versions of pre-existing games do more than simply move the action to your CRT, and *Shufflepuck Cafe* maintains that tradition. A click on the menu bar reveals a wide range of options for creating a barrier that moves back and forth across the middle of the table. With this blocker enabled and moving at a good clip, your opponent can seem like the least of your worries. Just getting the puck to his end of the table is a challenge in itself. The size and other characteristics of your paddle are also adjustable.

Shufflepuck Cafe succeeds on several levels. It beautifully ports air hockey to the PC/arcade environment, without diluting the original game. It also smoothly integrates features that are only possible on the PC. This one is truly for kids of all ages. ■

List Price: *Shufflepuck Cafe*, $34.95. **Requires:** 256K RAM, graphics adapter, DOS 2.0 or later. Broderbund, 17 Paul Dr., San Rafael, CA 94903-2101; (800) 521-6263, (415) 492-3200.

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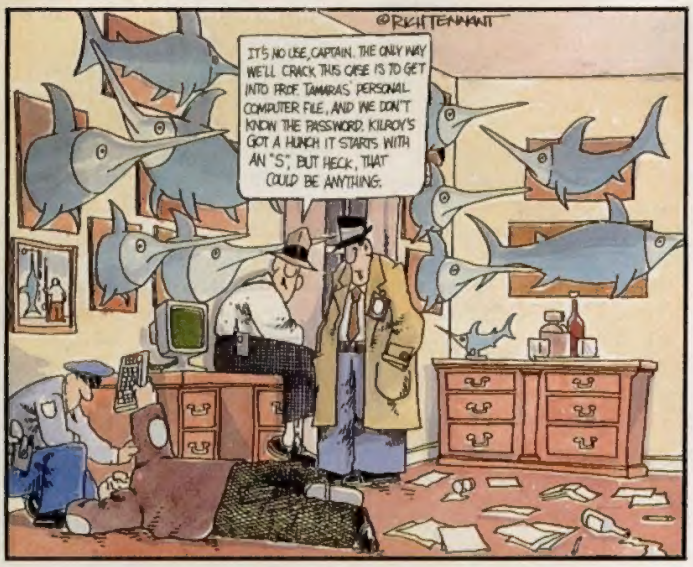
CIRCLE 158 ON READER SERVICE CARD

by Bill Howard

Abort, Retry, Fail?

The Lighter Side of Personal Computing



CARTOON: RICHARD TENNANT

Note: How Do You Select "No Keyboard Installed"?

"Note: If your system has no video monitor, select the Not Installed option to suppress error messages at boot time. If you select Not Installed and your system includes a video monitor, the monitor will operate anyway.

"Note: If your system has no keyboard, select the Not Installed option to suppress error messages at boot time. If you select Not Installed and your system includes a keyboard, the keyboard will operate anyway."

—Owner's manual for the Packard Bell PB900 80286, an AT clone

Mea Culpa

"[Mace] Emergency Room, like the Disk Doctor, restores damage to boot sectors and partition tables that would normally make a disk unreadable."

—*PC Magazine*, March 13, 1990

Your Choice: Babysit Or Sit at the Monitor

"Help Wanted: Computer entry person and/or babysitter. Flexible hours perfect for college students. Must have PC experience or babysitting experience. Attractive pay."

—*The Observer* (Fort Lauderdale, Fla.), January 29, 1990

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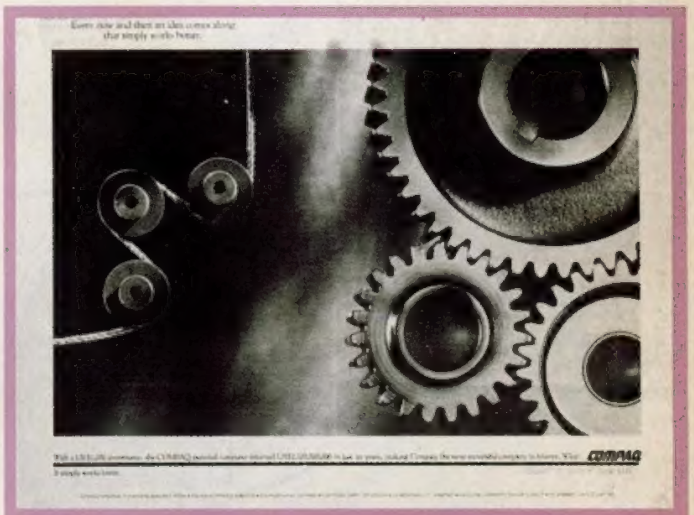
The first question to ask this new Computer Associates online, interactive help and training system, CA-Adroit/II, is, "Why is this PS/2 tower unit on its side?"

— *ComputerWorld*, April 9, 1990



"Every now and then an idea comes along that simply works better," proclaims this Compaq ad (above). It's unlikely that these gears work at all when all three are interlocked. Compaq later reprinted the ad (right) with the gears properly meshed.

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness, and completeness of entry are considered. Winners this issue: Woody Bahr (babysitter wanted), Bill Machrone (sideways PS/2), David Byboth (no monitor, no keyboard), Paul Keith (restores damage), Julius Moltgen (Compaq gears).

MFORT.

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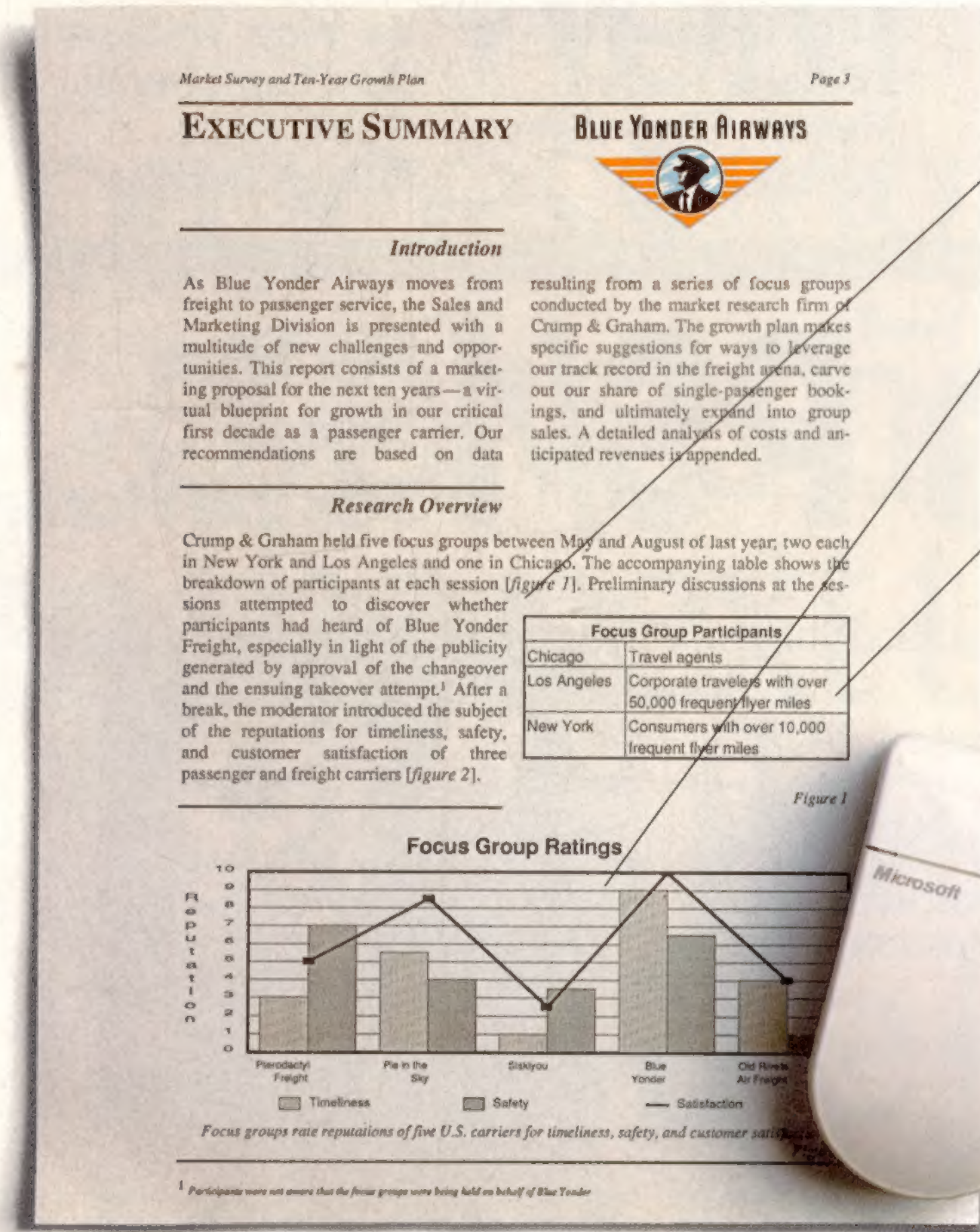

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